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THE

BOTANICAL WORKS

OF THE LATE

GEORGE ENGELMANN

COLLECTED FOR HENRY SHAW, Esq.

EDITED BY

WILLIAM TRELEASE AND ASA GRAY.

CAMBRIDGE, MASS.:
JOHN WILSON AND SON,
University Press.
1887.

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EDITORIAL PREFACE.

THIS complete collection of the Botanical Publications of the late Dr. ENGELMANN has been made at the suggestion and by means of the generosity of his fellow-townsman Mr. HENRY SHAW, who thus rears a memorial of his old friend and associate not less appropriate than those in bronze and marble, commemorating distinguished men, with which he has adorned the beautiful park which he gives to the city of St. Louis. He thus greatly obliges and benefits the botanists of our own and future times; for these publications were very widely scattered, and many of them were practically inaccessible to those who most needed to use them, and in their dispersed condition all were difficult to consult.

Their great extent will excite the surprise even of those who thought themselves well acquainted with Dr Engelmann's work. They are the more remarkable as being the result of studies and labors aside from the preoccupations and toils of a well-filled professional life, the fruit of hours which would naturally have been devoted to recreation and needful rest.

The classification and arrangement of the papers, and essentially the whole editorial labor has devolved upon the Engelmann Professor in the Shaw School of Botany, Dr. Trelease, under my supervision. The labor has been long and onerous. Most of the papers were published under conditions unfavorable to proof-reading; indeed, some of the Government publications were not revised by the author at all. The more serious misprints were found to be corrected in the author's own copies, and there were many other corrections or slight changes; all of which have as much as possible been attended to in the reprint.

It was difficult to recover the illustrations of Dr. Engelmann's papers, but it was evidently very necessary to have them. Through the kind attention of Professor Baird, the Secretary of the Smithsonian Institution, the steel plates of the seventy-six quarto engravings of the Cactaceæ of the Mexican Boundary Survey were found at Washington, and permission was obtained to use them. Several of them were badly rusted, and had to be repaired at considerable expense.

The twenty-four plates illustrating the memoir on the Cactaceæ of Whipple's exploration across the continent on the thirty-fifth parallel, and the three plates of Simpson's expedition had been engraved or drawn on stone, and the stones were not in existence. The figures have been excellently reproduced by Messrs. Armstrong & Co., of the Riverside Press, who took great pains to further our plans.

The original plates illustrating various octavo publications, such as the early monograph of Cuscutineæ, having been mainly lost or destroyed, they have been reproduced in photo-electrotypes;

and so they are incorporated into the letter-press, along with several original illustrations of the kind, such as the page of grape-seeds which illustrated Dr. Engelmann's well-known essay on the American Grape-vines in the Catalogue of Bush and Son and Meisner, and the large and excellent figures illustrating articles which he from time to time contributed to the "Gardeners' Chronicle," edited by his friend Dr. Maxwell T. Masters. Most cordial thanks are due to Mr. Bush and to Dr. Masters for the prompt and valuable gift of these electrotypes; also to the Smithsonian Institution for facilitating the transmission of the "Gardeners' Chronicle" electrotypes from London.

The artotype portrait of Dr. Engelmann which faces the titlepage, made by Brimmer and Kalb of St. Louis from the best photograph extant, is from the same negative as that published in the fourth volume of the "Transactions of the Academy of Science of St. Louis," and is used by the permission of the Academy.

It has been thought proper to append to this Preface the memorial in which the American Academy of Arts and Sciences expressed its sense of the loss which science had sustained in the death of Dr. Engelmann. But it is better that the writings should fully speak for themselves. That the present collection may most beneficially serve to perpetuate his memory and services among botanists is the hope and expectation of his surviving associate,

ASA GRAY.

CAMBRIDGE, MASSACHUSETTS,
March 25, 1887.

BIOGRAPHICAL SKETCH.

XIX

Reprinted from the Proceedings of the American Academy of Arts and Sciences, Vol. XX. pp. 516–522.

In the death of Dr. Engelmann, which took place on the 4th of February, 1884, the American Academy lost one of its very few Associate Fellows in the Botanical Section, and the science one of its most eminent and venerable cultivators. He was born at Frankfort-on-the-Main, Feb. 2, 1809, and had therefore just completed his seventy-fifth year. His father, a younger member of the family of Engelmanns who for several generations served as clergymen at Bacharach on the Rhine, was also educated for the ministry, and was a graduate of the University of Halle; but he devoted his life to education. Marrying the daughter of George Oswald May, a somewhat distinguished portrait-painter, they established at Frankfort, and carried on for a time with much success, a school for young ladies, such as are common in the United States, but were then a novelty in Germany. George Engelmann was the eldest of thirteen children born of this marriage, nine of whom survived to manhood. Assisted by a scholarship founded by "the Reformed Congregation of Frankfort," he went to the University of Heidelberg in the year 1827, where he had as fellow-students and companions Karl Schimper and Alexander Braun. With the latter he maintained an intimate friendship and correspondence, interrupted only by the death of Braun in 1877. The former, who manifested unusual genius as a philosophical naturalist, after laying the foundations of phyllotaxy, to be built upon by Braun and others, abandoned, through some singular infirmity of temper, an opening scientific career of the highest promise, upon which the three young friends, Agassiz, Braun, and Schimper, and in his turn Engelmann, had zealously entered.

Embarrassed by some troubles growing out of a political demonstration by the students at Heidelberg, Engelmann in the autumn of 1828 went to Berlin University for two years, and thence to Würzburg, where he took his degree of Doctor in Medicine in the summer of 1831. His inaugural dissertation, *De Antholysi Prodromus*, which he published at Frankfort in 1832, testifies to his early predilection for Botany, and to his truly scientific turn of mind. It is a morphological dissertation, founded chiefly on the study of monstrosities, illustrated by five plates filled with his own drawings. It was therefore quite in the line with the little treatise on the "Metamorphosis of Plants," published forty years before by another and the most distinguished native of Frankfort; and it appeared so opportunely that it had the honor of Goethe's notice and approval. Goethe's correspondent, Madame von Willema, sent a copy to him only four weeks before his death. Goethe responded, making kind inquiries after young Engelmann, who, he said, had completely apprehended his ideas of vegetable morphology, and had shown such genius in their development that he offered to place in this young botanist's hands the store of unpublished notes and sketches which he had accumulated.

The spring and summer of 1832 were passed at Paris in medical and scientific studies, with Braun and Agassiz as companions, leading, as he records, "a glorious life in scientific union, in spite

of the cholera." Meanwhile Dr. Engelmann's uncles had resolved to make some land investments in the valley of the Mississippi, and he willingly became their agent. At least one of the family was already settled in Illinois, not far from St. Louis. Dr. Engelmann, sailing from Bremen for Baltimore in September, joined his relatives in the course of the winter, made many lonely and somewhat adventurous journeys on horseback in Southern Illinois, Missouri, and Arkansas, which yielded no other fruits than those of botanical exploration; and finally he established himself in the practice of medicine at St. Louis, late in the autumn of 1835. St. Louis was then rather a frontier trading-post than a town, of barely eight or ten thousand inhabitants. He lived to see it become a metropolis of over four hundred thousand. He began in absolute poverty, the small means he had brought from Europe completely exhausted. In four years he had laid the foundations of success in his profession, and had earned the means for making a voyage to Germany, and, fulfilling a long-standing engagement, for bringing to a frugal home the chosen companion of his life, Dora Hartsmann, his cousin, whom he married at Kreuznach on the 11th of June, 1840. On his way homeward, at New York, the writer of this memorial formed the personal acquaintance of Dr. Engelmann; and thus began the friendship and the scientific association which has continued unbroken for almost half a century.

Dr. Engelmann's position as a leading physician in St. Louis, as well among the American as the German and French population, was now soon established. He was even able in 1856, without risk, to leave his practice for two years, to devote most of the first summer to botanical investigation in Cambridge, and then, with his wife and young son, to revisit their native land, and to fill up a prolonged vacation in interesting travel and study. In the year 1868 the family visited Europe for a year, the son remaining to pursue his medical studies in Berlin. And lastly, his companion of nearly forty years having been removed by death in January, 1879, and his own robust health having suffered serious and indeed alarming deterioration, he sailed again for Germany in the summer of 1883. The voyage was so beneficial that he was able to take up some botanical investigations, which, however, were soon interrupted by serious symptoms. But the return voyage proved wonderfully restorative, and when, in early autumn, he rejoined his friends here, they could hope that the unfinished scientific labors, which he at once resumed with alacrity of spirit, might still for a while be carried on with comfort. So indeed they were, in some measure, after his return to his home, yet with increasing infirmity and no little suffering until the sudden illness supervened which in a few days brought his honorable and well-filled life to a close.

In the latter part of his life Dr. Engelmann was able to explore considerable portions of his adopted country, the mountains of North Carolina and Tennessee, the Lake Superior region, and the Rocky Mountains and contiguous plains in Colorado and adjacent territories, and so to study in place, and with the particularity which characterized his work, the *Cacti*, the *Coniferæ*, and other groups of plants which he had for many years been specially investigating. "In 1880 he made a long journey through the forests of the Pacific States, where he saw for the first time in the state of nature plants which he had studied and described more than thirty years before. Dr. Engelmann's associates [so one of them declares] will never forget his courage and industry, his enthusiasm and zeal, his abounding good-nature, and his kindness and consideration of every one with whom he came in contact." His associates, and also all his published writings, may testify to his acuteness in observation, his indomitable perseverance in investigation, his critical judgment, and a rare openness of mind which prompted him continually to revise old conclusions in the light of new facts or ideas.

In the consideration of Dr. Engelmann's botanical work, — to which these lines will naturally be devoted, — it should be remembered that his life was that of an eminent and trusted physician, in large and general practice, who even in age and failing health was unable, however he would have chosen, to refuse professional services to those who claimed them; that he devoted only the

residual hours, which most men use for rest or recreation, to scientific pursuits, — mainly to botany, yet not exclusively. He was much occupied with meteorology. On establishing his home at St. Louis, he began a series of thermometrical and barometrical observations, which he continued regularly and systematically to the last, when at home always taking the observations himself, — the indoor ones even up to the last day but one of his life. Even in the last week he was seen sweeping a path through the snow in his garden to reach his maximum and minimum thermometers. His latest publication (issued since his death by the St. Louis Academy of Sciences) is a digest and full representation of the thermometrical part of these observations for forty-seven years. He apologizes for not waiting the completion of the half-century before summing up the results, and shows that these could not after three more years be appreciably different.

A list of Dr. Engelmann's botanical papers and notes, collected by his friend and associate Professor Sargent, and published in Coulter's Botanical Gazette for May, 1884, contains about one hundred entries, and is certainly not quite complete. His earliest publication, his inaugural thesis already mentioned (*De Antholysi Prodromus*), is a treatise upon teratology in its relations to morphology. It is a remarkable production for the time and for a mere medical student with botanical predilections. There is an interesting recent analysis of it in "Nature," for April 24, by Dr. Masters, the leading teratologist of our day, who compares it with Moquin-Tandon's more elaborate *Tératologie Végétale*, published ten years afterwards, and who declares that "when we compare the two works from a philosophical point of view, and consider that the one was a mere college essay, while the other was the work of a professed botanist, we must admit that Engelmann's treatise, so far as it goes, affords evidence of deeper insight into the nature and causes of the deviations from the ordinary conformation of plants than does that of Moquin."

Transferred to the valley of the Mississippi and surrounded by plants most of which still needed critical examination, Dr. Engelmann's avocation in botany and his mode of work were marked out for him. Nothing escaped his attention; he drew with facility; and he methodically secured his observations by notes and sketches, available for his own after-use and for that of his correspondents. But the lasting impression which he has made upon North American botany is due to his wise habit of studying his subjects in their systematic relations, and of devoting himself to a particular genus or group of plants (generally the more difficult) until he had elucidated it as completely as lay within his power. In this way all his work was made to tell effectively. Thus his first monograph was of the genus *Cuscuta* (published in the "American Journal of Science," in 1842), of which when Engelmann took it up we were supposed to have only one indigenous species, and that not peculiar to the United States, but which he immediately brought up to fourteen species without going west of the Mississippi valley. In the year 1859, after an investigation of the whole genus in the materials scattered through the principal herbaria of Europe and this country, he published in the first volume of the St. Louis Academy of Sciences a systematic arrangement of all the *Cuscutæ*, characterizing seventy-seven species, besides others classed as perhaps varieties. Mentioning here only monographical subjects, we should next refer to his investigations of the Cactus family, upon which his work was most extensive and important, as well as particularly difficult, and upon which Dr. Engelmann's authority is of the very highest. He essentially for the first time established the arrangement of these plants upon floral and carpological characters. This formidable work was begun in his sketch of the Botany of Dr. A. Wislizenus's Expedition from Missouri to Northern Mexico, in the latter's memoir of this tour, published by the United States Senate. It was followed up by his account (in the "American Journal of Science," 1852) of the Giant Cactus on the Gila (*Cereus giganteus*) and an allied species; by his synopsis of the Cactaceæ of the United States, published in the "Proceedings of the American Academy of Arts and Sciences," 1856; and by his two illustrated memoirs upon the Southern and Western species, one contributed to the fourth volume of the series of Pacific Railroad Expedition Reports, the other to Emory's Report on the Mexican

Boundary Survey. He had made large preparations for a greatly needed revision of at least the North American *Cactaceæ*. But although his collections and sketches will be indispensable to the future monographer, very much knowledge of this difficult group of plants is lost by his death.

Upon two other peculiarly American groups of plants, very difficult of elucidation in herbarium specimens, *Yucca* and *Agave*, Dr. Engelmann may be said to have brought his work up to the time. Nothing of importance is yet to be added to what he modestly styles "Notes on the Genus Yucca," published in the third volume of the Transactions of the St. Louis Academy, 1873, and not much to the "Notes on Agave," illustrated by photographs, included in the same volume and published in 1875. Less difficult as respects the material to work upon, but well adapted for his painstaking, precise, and thorough handling, were such genera as *Juncus* (elaborately monographed in the second volume of the Transactions of the St. Louis Academy, and also exemplified in distributed sets of specimens), *Euphorbia* (in the fourth volume of the Pacific Railroad Reports, and in the Botany of the Mexican Boundary), *Sagittaria* and its allies, *Callitriche*, *Isoëtes* (of which his final revision is probably ready for publication), and the North American *Loranthaceæ*, to which *Sparganium*, certain groups of *Gentiana*, and some other genera would have to be added in any complete enumeration. Revisions of these genera were also kindly contributed to Dr. Gray's Manual; and he was an important collaborator in several of the memoirs of his surviving associate and friend.

Of the highest interest, and among the best specimens of Dr. Engelmann's botanical work, are his various papers upon the American Oaks and the *Coniferæ*, published in the Transactions of the St. Louis Academy and elsewhere, — the results of long-continued and most conscientious study. The same must be said of his persevering study of the North American Vines, of which he at length recognized and characterized a dozen species, — excellent subjects for his nice discrimination, and now becoming of no small importance to grape-growers, both in this country and in Europe. Nearly all that we know scientifically of our species and forms of *Vitis* is directly due to Dr. Engelmann's investigations. His first separate publication upon them, "The Grape-vines of Missouri," was published in 1860; his last, a re-elaboration of the American species, with figures of their seeds, is in the third edition of the Bushberg Catalogue, published only a few months ago.

Imperfect as this mere sketch of Dr. Engelmann's botanical authorship must needs be, it may show how much may be done for science in a busy physician's *horæ subsecivæ*, and in his occasional vacations. Not very many of those who could devote their whole time to botany have accomplished as much. It need not be said, and yet perhaps it should not pass unrecorded, that Dr. Engelmann was appreciated by his fellow-botanists both at home and abroad; that his name is upon the rolls of most of the societies devoted to the investigation of Nature; that he was "everywhere the recognized authority in those departments of his favorite science which had most interested him," and that, personally one of the most affable and kindly of men, he was as much beloved as respected by those who knew him.

More than fifty years ago his oldest associates in this country — one of them his survivor — dedicated to him a monotypical genus of plants, a native of the plains over whose borders the young immigrant on his arrival wandered solitary and disheartened. Since then the name of Engelmann has, by his own researches and authorship, become unalterably associated with the Buffalo-grass of the plains, the noblest Conifers of the Rocky Mountains, the most stately Cactus in the world, and with most of the associated species, as well as with many other plants of which perhaps only the annals of botany may take account. It has been well said by a congenial biographer, that "the Western plains will still be bright with the yellow rays of *Engelmannia*, and that the splendid Spruce, the fairest of them all, which bears the name of Engelmann, will still, it is to be hoped, cover with noble forests the highest slopes of the Rocky Mountains, recalling to men, as long as the study of trees occupies their thoughts, the memory of a pure, upright, and laborious life."

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I.

DE ANTHOLYSI PRODROMUS: DISSERTATIO INAUGURALIS PHYTOMORPHOLOGICA,

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FRANCOFURTI AD MOENUM. PROSTAT APUD H. L. BROENNER.

MDCCCXXXII.

SOCIETATI NATURAE SCRUTATORUM SENKENBERGIANAE IN HAC IPSA URBE PATRIA FLORENTI HASCE QUALESCUNQUE PRIMITIAS D. D. D. AUCTOR.

PRAEFATIO.

DISSERTATIUNCULAM hanc quod in lucem sum prolaturus, excusationi mihi sunt universitatis Herbipolitanae leges, quae tale quid scribi jubentes hoc auctoris inceptum securius reddunt a vituperatione. Quibus legibus cum obtemperarem, libenter quoque usus essem facultate, quam dat gratiosus ille medicorum ordo, scribendi linguâ vernaculâ, quae vix tantum intra emortuae istius linguae terminos compesci se sinunt; sed alia voluit mos urbis patriae. Philologus, qui latinitatem tantum spectet, non videbit hoc opellum; naturae autem studiosus neglectâ formâ in rem animum advertat. Quod de linguâ philologo, artifici mihi dicendum est de iconibus, quas, ut [6] omnia accuratissime perficerentur, ipse lapidi inscripsi.

His praemissis, quae de re ipsâ mihi dicenda sunt, meliore proferam animo, quamquam, in thematis optione liber, alius voluntatem non habeo, quâ nitar. Jam enim prius botanicen amavi ac colui, cumque Heidelbergae Musarum signa sequerer, ducentibus amicissimis atque praestantissimis viris ALEXANDRO BRAUN et CAROLO SCHIMPER eo perveni, ut ratione naturae magis congruente indagandas esse plantas sentiam, quâ ratione jam dudum magnus GOETHE, qui noster est non ob communem urbem natalem, sed ob communitatem patriae, quique omnes ingenio nihil non perlustrante jungit, clarissimo lumine nobis praelucet. Sed inde ab illo tempore medicinae operam navans horas subsecivas tantum huic scientiae relinquere poteram, quae non minus gravis est atque amabilis discipulo. Attamen ex hâc solâ ego aliquod, quod mihi sit proprium, quodque non nullâ

dignum esse videatur studiosi indagatione, afferre poteram, adjuvantibus compluribus VV. [7]
DD., inter quos inprimis amicissimus ALEX. BRAUN maximâ cum gratiâ nominandus.

Qui, quod hanc mihi rem tractandam sumpserim, miretur, velim ut introductione lectâ sententiam mutet. Jam hoc unum dicendum puto, mihi neque antholysim, neque in universum doctrinam de abnormitatibus cognoscendam ultimam esse studii metam ; nihil volui, nisi ad magnum systema organographiae, physiologiae ejusque, quae omnia in se continet, doctrinae de metamorphosi plantarum particulam addere.

Terminos quosdam novos excuses, cum non ex vanâ termonomaniâ orti sint, sed ex necessitate nonnulla brevius accuratiusque nominandi et definiendi.

Nimis auctum est opus inter colligendum, magnâ naturâ semper semperque novam mihi praebente materiem ; jam libello finis erat sistendus, sed, cum quae haberem nimia essent,
hic nonnisi epitomen profero ; integrum tractatum spero fore ut postea, si VV. DD. judicium [8]
non nullam mihi dederit adhortationem, studio continuo auctum et emendatum in publicum prodere possim.

INTRODUCTIO.

1. NATURA vivit; ejus vita conspicitur in formatione et evolutione. Sicuti autem quod vivit diversos tenet gradus, sicuti vita ipsa diversâ est dignitate, ita evolutio quoque et formatio diversa est in homine ejusque spiritu, in bestiis, in plantis, nec minus in terrâ mundoque. Clarissime apparet evolutionis progressus in plantis, simplicissimae in iis leges exprimuntur, quae obscure tantum in corporibus coelestibus indicantur, quarum implicationes in animalibus et in homine difficilius solvuntur. Ex plantarum igitur historiâ (historia autem est narratio evolutionis ejusque processus) facilius et certius communes evolutionis leges cognoscemus.

2. In animalium et formâ et vitâ unitas, organa quidem structurâ non minus ac functione sunt diversa, eundem tamen finem spectant. Inde a conceptionis momento animal complures gradus percurrit, dum autem maxima est formationis vis, in utero vel ovo absconditum est; gradus per tempora solum distinguuntur, ita ut, cum posteriores emergant, priores transierint.

3. Plantae vero organa externa et, quae dicunt, peripherica nobis offerunt; quae inter se [12] simillima invenimus, singula autem, altero quodammodo libero ab altero, destinationi vitae vegetabilis respondere videntur: planta est multitudo. Unitas autem in solis plantarum organis, in foliis, posita est, quae unâ cum interfoliis[1] (cognatis caulis partibus) individua dicamus, neque, uti botanicis nonnullis videbatur esse justum, ramos, gemmasve. Quomodo folia, individua vegetabilia, per totam plantarum vitam variis formis appareant, et in ipsis floribus mutata tantum conspiciantur, ex iis quae infra dicemus, manifestum fiet.

4. Accuratius autem indagantes haud fugiet, ne folia quidem individualia esse sensu strictiore; folia enim vel in plantis quas perfectissimas esse arbitramur, ad divisionem tendunt et multiplicationem; stipulae a foliis sejunguntur, quae ipsa laciniantur et in foliola diffinduntur, nec minus gemmae in margine et intra dentes procreantur (*Bryophyllum calycinum*, *Malaxis paludosa*, *Cardamine pratensis*, aliae). Non audacius igitur agere arbitramur statuendo, plantarum organa ejusmodi, ut vita plantarum peripherica sit et externa, ad multitudinem tendere, et unitatem semper discerpere, notionem igitur individui[2] solis respondere animalibus, et improprie tantum nec [13] nisi comparationis causâ plantis ejusve organis attribui.

5. Cunctae appendices plantae, quas omnes folia[3] latiore significatione dicimus, in certâ quâdam serie disponuntur. Infima caulis folia, folia caudicina, parva sunt, imperfecta, saepe squamiformia; tum in caule vel etiam in caudice magis expansa, formis tamen incultis, sine gemmis inveniuntur; folia autem caulina videmus magis evoluta, dentata, dissecta, etc., plerumque ex axillis

[1] Geiger, Mag. f. Pharmac. 1830, Jan. pag. 2.

[2] Individuum semper est unum, nec vero unitas semper individualis; regnum quoque vegetabile (cf. Göthii plantam primitivam, Urpflanze, in itineris per Italiam descriptione), classes plantarum, familiae, genera, species unitatem ostendunt menti, sensibus planta ipsa, ramus, flos, fructus; folium autem verum individuum esse videbatur.

[3] Folia linguâ vernaculâ egregie Blätter propter expansionem nominantur.

gemmas proferentia foliiferas, quae omnia dicimus folia vegetationis (Laub, phylla, frondes ?); haec sequuntur folia subfloralia (bracteae, involucra, calyces exteriores), quae in axillis flores fovent vel ramos floriferos; nisi jam sterilia evadant et transitum nobis ostendant ad folia floralia (folia calycina s. sepala, f. perigonialia s. tepala DeC., f. corollina s. petala, f. pollinaria s. stamina, f. pistillaria s. folia, quae pistillum constituunt, quae singula clausa carpia dicenda sunt), quibus, caulis formatione oppressâ, normalis foliorum formatio finitur, quâ de re infra latius disserendum, si opus videatur post ea, quae jam ante hos XL annos *Göthe* in libello, de metamorphosi ingeniosissime agente, docuit.

Videmus altiores foliorum gradus fieri per inferiores, neque ex inferioribus, qui ipsi nondum pereunt, sed durant; formationes inferiores juxta altiores observantur; ergo gradus non per tempora, ut in animalibus, discreti sunt, simul magis per spatia.

6. Plantam igitur demonstrasse mihi videor, aptissimam esse, in quâ explorentur formationis processus atque evolutionis leges propter structuram simpliciorem, propter vitam materiali magis addictam formationi, propter organa extrorsum posita, propter manifestos et per spatium progredientes evolutionis gradus. [14]

7. Formatio, evolutio progrediens, metamorphosis, in singulis naturae formis non minus ac in cunctâ naturâ apparet, raro autem sensim fit et paulatim; plerumque per distinctiores gradus et quasi saltuatim progreditur. Tum novus quisque gradus, qui gradus tantum est et seriei articulus facile singulare aliquod, distinctum et proprium esse videtur. Diligentius autem indagantibus obviam fit nisus naturae et intentio ex alio gradu in alium perveniendi, qui nisus fluctuatione formationis et formis transitivis manifestus fit. Nam tendenti ad finem metaphorphosi est promotio et repugnatio et normalis amborum proportio. Nutationes hujus proportionis efficiunt formationes transitivas, abnormitates proportionis evolutiones abnormes.[4] Quae ipsae viam nobis ostendunt expeditiorem et intervalla quae sunt inter diversos gradus explent, ita ut metamorphoseos progressum intelligamus. Abnormitates enim in ultimos naturae recessus nos ducunt, et, quae vitae rationem oculis abscondunt, velamina revolvunt. Ita fieri potest, ut conjungamus quae divisa esse videantur, separemus leges semper veras ab iis, quae mutari possunt, cognoscamus grandem in innumeris ejus formis naturae simplicitatem.

8. Quantum his ultimis lustris disquisitiones abnormitatum animalium contulerint ad intelligendum normalem formationis processum, exponere non opus est. In plantis autem earum investigationem eodem esse pretio dignam, nisi majore, consequi mihi videtur ea, quae supra dicta sunt. In animalibus porro vitia primae formationis dicta nonnisi in perparvâ vitae periodo inveniuntur, in plantis vero exsistere possunt per omnem earum vitam vegetationi dicatam. [15]

9. Abnormes evolutiones fieri vidimus ex nimio motu et ex nimiâ impeditione. Illae, in quibus praetermittitur unus alterve gradus, rariores sunt. Multo saepius autem invenimus formationes nimiâ impeditione effectas, quae formationes impeditae (Hemmungsbildungen) vocantur, quas, ut perveniamus ad ipsam rem hâc in dissertatiunculâ tractandam, opus est, ut paulo accuratius inspiciamus.

DE FORMATIONIBUS IMPEDITIS.

10. Dicimus *impeditas* omnes formationes in quibus evolutio, quominus rite progrediatur, impedita est. Animalium formationes impeditae eo videntur, quod evolutio gradum, ad quem pervenerit, non relinquat, vel tardius saltem procedat, — quae autem in plantis raro tantum

[4] Monstrositates dicere non possumus, notio enim haec est prorsus subjectiva, et id indicat, quod sensibus, regularia conspicere assuetis, videatur a regulâ abhorrere, quod tale sit, quod **monstretur**.

inveniuntur. Saepe vero formatio seriei organorum impeditur, ita ut gradus aliquis constantius teneatur, et loco altioris gradus semper vel per aliquod spatium tempusque ejusmodi solum gradus formationes appareant.

11. In omnibus vegetabilis vitae gradibus evolutio cohiberi potest. Cum vero inprimis tractandum proposuissemus florem, etiam floris solius formationes impeditas contemplare [16] liceat. Neque autem inflorescentia ejusque folia (folia subfloralia) omittenda sunt.

In flore, in quo plerumque singuli gradus uno duobusve verticillis efformantur, formationis impedimentum efficit, ut verticillorum numerus augeatur, nec non huc referenda est multiplicatio numeri foliorum in ipsis verticillis. Quae multiplicatio saepe continuâ serie per omnes floris verticillos invenitur. Id quoque formationis impedimento ortum esse dici potest, ex quo, valido progressu favente, saepe altior gradus et aucta seminum generatio attingitur; saepe autem tales flores, oculo speciosi, steriles evadunt.[5] Ea tandem abnormitas formatio impedita est, quâ nisi numerus, magnitudo tamen foliorum verticilli cujusdam ita augetur, ut folia verticillorum sequentium capiant damnum.

1. Formatio Foliorum Subfloralium Impedita.

12. Impeditionis, quâ florum evolutio retardatur, exemplum praebent, *Calla palustris* et *C. aethiopica*, quae interdum binis spathis instructae sunt. In graminibus nonnullis, e. g. in *Bromo velutino* glumarum aucto numero flores plane supprimuntur, id quod in *Hyacintho monstroso* quoque obviam fit, cujus bracteae nil nisi ramos bracteatos proferunt. *Scabiosa columbaria* cum denso foliorum fasciculo loco capituli invenitur; et *Hieracium fallax* reperi, cujus anthodium foliosum paucos tantum vel nullos flosculos continebat; *Crepidis foliis* exemplar, in [17] horto botanico Francofurtensi cultum, flosculos non profert, sed ex capitulo dense folioso anthodia secundaria emergunt simili modo constructa. *Lythrum Salicaria* haud raro auctarum bractearum racemum floribus carentem praebet. *Plantaginis majoris*,[6] *Veronicae spicatae*, *Echii vulgaris*,[7] *Meliloti arvensis* et *Rubi fruticosi*[8] abnormitates observatae sunt *Hyacintho* illo haud absimiles; loco spicarum vel singulorum florum paniculae ramosae solis bracteis instructae obviam fiunt. *Dianthus caryophyllus* denique, quem sub *imbricati*[9] nomine in hortis interdum videre licet, aucto squamarum calycinarum numero, quae spicam longiorem flore incompleto vel nullo terminatam efformant, singularem suum acquirit adspectum.

2. Formatio Foliorum Calycinorum Impedita.

13. Multiplicatio calycis et suppressio ceterorum foliorum floralium in *Stachye lanatâ* hortorum conspicitur; *A. Braun* in *Myosoti palustri* eam vidit et *Courtois*[10] in *Veronicâ mediâ* (?) una cum gemmis axillaribus. In *Campanulâ rapunculoide* omnes hujus abnormitatis gradus apparent, a multiplicatione calycis sine altiorum graduum detrimento usque ad suppressionem eorum totalem.[11] In *Aquilegiae vulgaris* flore pleno stellato et in *Nigellae damascenae* flore pleno [18] partim vel prorsus delentur verticilli interiores.

[5] De Candolle tales flores, numero partium auctos, concrescentiâ et abortu, et Nees von Esenbeck (Handbuch der Botanik, II. 164) divisione simplicium foliorum laterali ortos esse statuit, de quibus explicationibus plura dicere superfluum. — De verticillorum naturâ, singulorum foliorum dignitate et successione vide infra. Cf. praeterea A. Braun de strobilis in Nov. Act. Leop., Vol. XV. pars 1.

[6] A. Braun in litt.

[7] Bot. Zeitung, 1829, pag. 441.

[8] Spenner, Flora Friburg., pag. 744.

[9] Nov. Act. Leopold., Vol. XV. tab. 28, fig. 3. — Ephem. Nat. Cur. Cent., 3 et 4, Ann. 1715, p. 368. — Botan. Magaz., tab. 1622.

[10] Bydragen tot de Natuurk. Wetensch., 2 Deel, pag. 226.

[11] Vide Tab. III. fig. 15 et 16. Cf. Weinmann, Phytanth. iconogr. Nro. 292, c.

3. Formatio Foliorum Perigonialium Impedita.

14. Omnes gradus hujus impeditionis in *Tulipâ Gesnerianâ*, *Lilio candido* (una cum apostasi) et multis aliis *Liliaceis* cultis observare licet; nec non in *Colchico autumnali*, *Croco sativo*, *Convallariâ majali*, aliis Monocotyledoneis. Inter Dicotyledoneas, quibus perigonium attribuendum est, invenitur haec abnormitas in *Calthâ palustri*, *Anemone hortensi*, *Clematide Viticellâ*, aliis.

4. Formatio Foliorum Corollinorum Impedita.

15. Multi flores pleni, quibus horti abundant, huc pertinent. Flores semipleni illi dicuntur, quorum folia genitalia haud plane abolescunt multiplicatione foliorum corollinorum, in plenissimis autem floribus prorsus deleta sunt. — Exempla fusius afferre haud necessarium; in familiis *Primulaceârum*, *Jasmineârum*, *Solaneârum*, *Contortârum*, *Polemoniaceârum*, *Campanulaceârum*, praesertim *Rosaceârum*, *Caryophyllearum*, *Violariarum*, *Malvaceârum*, *Cruciferârum*, *Ranunculaceârum*, aliis frequenter occurrunt. Icones plurimae prostant, multae autem satis viles, et minime accuratae.

5. Formatio Foliorum Pollinarium Impedita.

16. Haec formatio impedita raro invenitur; in solis *Diantho caryophyllo* et *Saponariâ officinali* loco duorum tres vel quatuor verticillos staminum vidi, et in *Cheiranthо Cheiri* et *Thlaspi arvensi* observavi quatuor breviora stamina, loco duorum. Pistillis tali abnormitate [19] suppressis flores masculi cum staminum numero aucto orirentur; nondum autem tale quid inveni, normaliter vero in *Poterio* exstare videtur, quod certo ad genus *Sanguisorbae* pertinet; nec minus in quibusdam *Aceris* speciebus.[12]

6. Multiplicatio Foliorum Pistillarium.

17. Haud legitime hanc abnormitatem formationibus impeditis adnumerare possumus; etsi autem folia, quorum evolutio supprimatur, non sequantur, saepe semina, quominus maturescant, impediuntur. Multiplicationem verticilli gynoecei in *Gentianâ*,[13] *Brassicâ oleraceâ*,[14] *Papavere somnifero*,[15] *Aquilegiâ vulgari*[16] observaverunt botanici; nec minus in fructibus, quos *Jaeger*[17] appellat praegnantes, et in parte eorum, quibus nomen dat pullulantium, in *malis*, *pyris*,[18] *malis aurantiis*, aliis. Auctus singulorum carpiorum in eodem verticillo collectorum numerus in *Pruni* et *Amygdali*[19] speciebus (2 — 5 carpia) occurrit, in *Mercuriali annuâ* (3 — 4 c.), *Euphorbiâ Paraliade*[20] (5 c.), *Medicagine lupulinâ* (2 — 5 c.), *Gleditschiâ*[21] (2 c.), *Mimosâ*[21] (5 c.); simili modo in *Diantho* (5 — 6) et *Cruciferis* (3 — 4 — 10) interdum folia pistillaria plura, quam fieri [20] solet, ovarium constituentia reperiuntur.[22]

7. Auctus Foliorum Floralium per omnes Verticillos Numerus.

18. Flores, quorum omnes verticilli solito majorem foliorum numerum continent, quos pleiomeres (πλείων, μέρος) vocarem, in multis plantis (*Rutâ*, *Chrysosplenio*, *Adoxâ*, aliis) vix abnormes sunt. *Paris* invenitur pentameris et hexameris, *Tulipa*, *Ornithogalum*,[23] *Allium*, aliae *Liliaceae* 7 — 12meres. Inter Dicotyledoneas *Anagallis*, *Primula*, *Campanula*, *Sambucus* (6 — 18meris), *Solanum* (inprimis *S. Lycopersicum*), *Symphytum*, *Fuchsia*, complures *Umbelliferae*, *Philadelphus*,

[12] Cf. Spenner, Flora Frib., pag. 1084.
[13] De Cand. Organogr., Tab. XL. fig. 6 et 7.
[14] Vide Tab. IV. fig. 2.
[15] Schimper in der Botan. Zeitung 1829, pag. 426.
[16] A. Braun in litt.
[17] Missbildungen, pag. 221.
[18] De Cand. Organogr., Tab. XLIII.
[19] Tab. I. fig. 4.
[20] Roeper in Linnaea, II. pag. 85.
[21] De Cand. Organographie.
[22] Bot. Zeitung 1829, pag. 433.
[23] Linnaea, IV. pag. 383. Inde Fingerhuth novam constituit speciem, Ornithogalum octandrum! Cf. Bot. Zeitung 1828, pag. 592.

Rosa, *Rubus*, *Clematis*, *Ranunculus*, multae aliae numero partium variant. *Brassicam Napum* cum verticillis trimeribus[24] inveni, et *Brassicam oleraceam* cum tetrameribus, etc. Etiam quae in *Compositis* observantur, huc referre licet; calathides interdum latiores fiunt, flosculorum ligulatorum series in disco oritur, denique calathis in duas dividitur; id quod praecipue cum caulis fasciatione conjunctum est, simili modo, quo illi flores pleiomeres cum fasciatione inveniuntur.

8. Amplificatio Corollae. [21]

19. Auctionem magnitudinis non minus ac auctionem numeri foliorum formationibus impeditis adnumerandam esse, jam dixi. Quae auctio praecipue in foliis corollinis observata, staminibus magis evolutis, pistilla debilitat vel supprimit in multis *Labiatis* praecipue in *Menthâ*, *Thymo*, *Lamio*, aliis. Huc fortasse *Circaea intermedia* pertinet, quae nonnisi forma *C. alpinae* esse videtur; ipsa *Campanula Speculum* et *hybrida* jungendae et hâc ratione explicandae sunt.

Contraria in aliis familiis occurrunt, amplificatione enim corollae stamina abolescunt in *Compositarum Radiatarum* floribus, quos plenos vocant hortulani, in *Bellide*, *Astere*, *Tagete*, multis aliis, inter quas *Calendula officinalis* eo mirabilis est, quod omnes disci flosculi fertiles fiunt. Nec non in *Scabiosâ arvensi* haec abnormitas observatur.

In nonnullis plantis stamina et pistilla supprimuntur corollae amplificatione; huc *Viburnum Opulus* et *Violae* nonnullae, inprimis *V. mirabilis*. Etiam *Hydrangea hortensis* calyce corollino amplificato hic potest nominari.

20. Ab his formationibus impeditis magna abnormitatum classis eo distinguenda est, quod non impedito progressu sed manifesto regressu oriuntur. Huc pertinent metamorphoses vere retrogradae, quibus organa, dum evolvuntur, afficiuntur, nec non inferiorum graduum, qui jam superati erant, repetitio. — Quae si in flore apparent, *antholysis* est, et de hâc, ejus nomine et naturâ, ejus signis, speciebus et combinationibus, ejus causis et conclusionibus ex eâ [22] ducendis, in hâc dissertatiunculâ agam.

[24] Verticilli Cruciferarum normales dimeres sunt; vide A. Braun, de squamarum in strobilis ordine, in Nov. Act. Leopold., Vol. XV. Tab. XXXII. fig. 1.

DE ANTHOLYSI.

21. Nomen *antholysis*, quantum scio, in Spenneri Florâ Friburgensi primum usurpatur. Compositum est ex verbo *ἄνθος*, flos, et *λύειν*, solvere, ergo floris solutionem significat, totalem vel partialem unitatis in flore eversionem.

Antholysis est commutatio abnormis organorum floris normalem in modum constitutorum, metamorphoses vere retrogradae, quas patiuntur in evolutione, transformatio foliorum altioris gradus in inferiorem, nisus ad finem diminutus et sublatus.

22. Antholysis facile distinguitur a plurimis aliis abnormitatibus; cum solis formationibus impeditis interdum, ut confundatur, fieri potest. Multo autem differre eo videtur, quod in foliis floralibus, antholysi mutatis, semper vel in numero, vel in formâ, vel in materie, vel in collocatione, vel in alio ad cetera organa respectu vestigia evolutionis ad altiorem gradum destinatae inveniantur. Interdum vero ne minimam quidem differentiam observamus; e. g. *Rosae* flos aut formatione petalorum impeditâ, quâ stamina partim supprimuntur, aut mutatione staminum exteriorum in petala, semiplenus fieri potest; ipsae formationes intermediae, partim antheras partim petala significantes, haud certo evolutionem retrogradam indicant, eo minus, cum antholyses et formationes impeditae saepius conjunctae occurrant.

23. Secundum organa floris et secundum mutationes eorum multos antholysis modos [24] discernimus; certos autem fines inter eos constituere nequimus, cum antholyses non factae sint individua.

In commutationes hic inquirimus abnormes, distinguimus igitur antholyses secundum mutationis rationem. Aliae distributiones, optimae sane ei, qui alia spectans hanc rem tractaret, fieri possunt secundum floris organa et secundum plantarum familias. Minus apte disponerentur secundum causas, secundum perfectionem et alias rationes.

I. ANTHOLYSES, QUIBUS SOLA FOLIA FLORALIA LABORANT, SINE AXIS MUTATIONE.

1. Regressus.

24. Regressus (Rückbildung) simplicissima foliorum floralium metamorphosis retrograda est, quâ haec antecedentis gradus foliis similia fiunt.

Interdum plurima vel omnia folia floralia talem in modum mutantur, vel unius tantum verticilli folia; ubi autem singula solummodo folia corripiuntur, videmus ea, quae externa sunt et prima, maxime mutari, plane secundum leges successionis in dispositione foliorum.[25]

[25] Cf. A. Braun, Ordnung der Schuppen an den Tannzapfen in den Nov. Act. Leop., Vol. XV. pars 1.

a. *Regressus Foliorum Pistillarium in Folia Pollinaria.*

25. Haec metamorphosis nonnisi certo quodam sensu nominari potest regressus; quin autem reverâ inveniatur, haud dubitandum, quidquid dicant *Schaltz*,[26] *Gmelin*[27] et alii. Sane [25]
opposita sunt folia pistillaria et pollinaria, magis opposita, quam ulla alia in plantarum evolutione. In naturâ autem nulla infinita est contrapositio, atque formationes intermedias transitivasque et ratione suspicamur, et observatione demonstramus. Quâ ipsâ autem contrapositione argumentamur, folia pollinaria et pistillaria ejusdem esse dignitatis, nec folia pollinaria esse formationem transitivam inter folia caulina et folia pistillaria, sed foliorum caulinorum vires, quibus ipsa vere hermaphrodita gemmas generant, in oppositos, quos dicunt, factores divisae in foliis pollinaribus et pistillaribus apparent, quae conjuncta procreant indifferentissimum semen.[28] Itaque, alterum folium altero magis evolutum esse, dici non potest; mutatio tamen foliorum pistillarium in folia pollinaria inter antholyses numeranda est, cum mutatio *retrograda* sit in formam gradus antecedentis, et unitatem perfectionemque florum laedat.

26. Observata est haec metamorphosis in *Salice cinereâ*, *silesiacâ* et *caprea*[29] nec minus in *Salice babylonicâ*,[30] cujus arbores, alias semper femineae, in ramis nonnullis fere solos [26]
flores masculos proferebant; et in *Euphorbiâ*.[31] Intra *Primulae acaulis* paulo aperta ovaria *Schimper*[32] in valvis antheras polliniferas animadvertit. *Gentianam campestrem* conspexit *Roeper*[33] cum mutatione alterius carpii in antheram, altero paene integro. In *Campanulâ persicifoliâ*[34] et *C. rapunculoide*[35] vidi organon antherae simile in uno stylo; denique in *Cheiranthi Cheiri* flore dimidium folium pistillare in antherae thecam conversum observavi.

b. *Regressus Foliorum Pistillarium in Expansiones Petaloideas.*

27. Folia pistillaria clausa non aperiuntur hâc antholysis formâ, sed stigma et stylus expanduntur, germen autem ipsum sensim abolescit, usquedum plane deletum sit, et petaloideum folium locum occupaverit.

Expansiones tales occurrunt in *Colchico autumnali*,[36] *Diantho caryophyllo*,[37] *Hibisco Rosâ sinensi*,[38] *Papavere somnifero*,[39] *Nigellâ arvensi*[40] semper in floribus plenis; huc quoque pertinent *Anemones hortensis* flores pleni, quorum germina, staminibus integris, evanita sunt. In *Scabiosâ arvensi* stigmata elongati styli in foliola coerulea mutata vidi; similem in *Lonicerâ* [27]
Periclymeno observationem *Koning*[41] describit.

c. *Mutatio Parastemonum in Stamina.*

28. Parastemones intra verticillos staminum collocati haud frequenter inveniuntur, ubi autem adsunt, facile in vera mutantur stamina. Quod occurrit in *Eupomatiâ laurinâ*,[42] *Aquilegiâ vul-*

[26] Natur der lebendigen Pflanze, I. pag. 294.

[27] Naturwissenschaftl. Abhandlungen von einer Gesellschaft in Würtemb., I. Bd. pag. 303. Argumenta, quae contra afferuntur, vel plane negativa sunt, cum doctissimi illi non satis observassent naturam; vel theoretica sunt et falsis principiis nituntur, e. g. Gmelini assertione (pag. 301): Je höher die Bildung vorangeschritten ist, desto weniger ist ein Rückschritt möglich! Sane tale quid omnem observationem superfluam redderet.

[28] Improprie igitur de hermaphroditis plantis floribusque loquuntur; flos sic dictus hermaphroditus talis est, in quo folia maxime diversa, sexu nempe (uti etsi multis contradicentibus optime ajunt) distincta, propius cohibentur, ergo strictius sibi opponuntur, quam in floribus unisexualibus; altiorem igitur flores hermaphroditi attingunt gradum.

[29] Uebersicht der Arbeiten der schles. Gesellsch. f. vaterländ. Cultur., 1825.

[30] Schimper in der botanischen Zeitung 1829, pag. 422.

[31] Roeper Enum. Euphorb., pag. 53.

[32] Bot. Zeitg. 1829, pag. 424. Spenner Fl. Friburg., pag. 1061.

[33] Linnaea, I. pag. 457.

[34] Tab. III. fig. 10 et 11.

[35] Ibidem, fig. 14.

[36] Jaeger, Missbildgen., pag. 76.

[37] L. c.

[38] L. c., pag. 77.

[39] Goethe, Metam. d. Pflanzen, § 80.

[40] Jaeger, Missb., pag. 77.

[41] Bydragen tot de Natuurk. Wetensch., II. pag. 226, Tab. II.

[42] R. Brown, General Remarks, Tab. II.

gari[43] et *Paeoniâ Moutan.*[44] Huc quoque id pertinet, quod saepius in *Sempervivo tectorum* observatum est, cujus sic dicta nectaria in stamina vel pistilla conversa erant.

d. *Regressus Foliorum Pollinarium in Folia Corollina.*

29. Affinitatem amborum organorum jam dudum cognoverunt botanici, et transitus inter ea diligenter observaverunt. Utrum autem anthera an filamentum in petalum mutetur, haud certum esse videtur; in *Rosâ, Diantho, Papavere* utrumque conspicitur; *De Candolle* falli videtur contendendo ex antherâ fieri cucullatum petalum, ex filamento autem planum; *Aquilegiae* exemplum, quod affert, falsum. Plerumque sensim expanditur planumque fit folium pollinare, et antherae rudimenta in medio, saepius in margine relinquuntur. Mutatio frequentior est in floribus, quorum corollae magnae, coloratae, eleutheropetalae (polypetalae) sunt, et stamina plurima. Saepe, id quod jam dixi, hic regressus cum corollae formatione impeditâ conjunctus.

30. Omnia, quae inveniuntur, exempla afferre, cum frequentissima sint, superfluum; [28] solas dicam *Primulam, Veronicam,*[45] *Orobanchen,*[46] *Vincam,*[47] *Gentianam,*[48] *Viburnum,*[49] *Loniceram,*[50] *Scabiosam,*[51] *Campanulam;*[52] inter plantas eleutheropetalas *Daucum, Medicaginem, Spartium, Anthyllin, Coronillam, Clitoriam,*[53] multas *Rosaceas* et *Caryophylleas, Violam.* Mira est haec metamorphosis in *Malvaceis;* in *Alceâ roseâ* ex columnâ androeceâ parvi, ut ita appellem, flosculi staminibus et petalis instructi fiunt, quâ de re infra plura. Regressus ille porro invenitur in *Cruciferis* compluribus, *Citro, Papavere,* multis *Ranunculaceis.*

e. *Regressus Foliorum Pollinarium in Folia Perigonialia.*

31. De hâc metamorphosi eadem quae de modo memoratâ dicenda sunt. Exempla nobis praebent *Tulipa* multaeque *Liliaceae* cultae, nec non *Iris.*[54] Haud rarus hic multiplicationis modus in *Calthâ palustri, Anemonis,* aliis.

f. *Regressus Foliorum Pollinarium in Folia Calycina Colorata.* [29]

32. Solum occurrit in floribus, quorum petala sepalis coloratis regressu similia facta sunt; tum stamina statim fiunt sepaloidea, petalorum formâ praetermissâ. In *Nigellâ damascenâ, Aquilegiâ vulgari, Delphinio* tale quid invenitur.

g. *Regressus Foliorum Corollinorum in Folia Calycina.*

33. Haec antholysis certo quodam sensu virescentiae adnumeranda; sed praeter id quod non omnes calyces sunt virides, regressui ita affinis est, ut separare eam haud liceat. Ubi non tam regressus, quam virescentia vera adest, semper totus flos una laborat. Saepe simul staminum regressu corolla alia oritur, saepe etiam prorsus nova corolla additur.[55] Regressus petalorum apparebat in *Teucrio Chamaedrye, Vincâ minore,*[56] *Campanulâ persicifoliâ,*[57] et *C. rapunculoide,*

[43] De Candolle, Organographie, I. pag. 427.
[44] Link, Elem. Philos. Bot., R. Brown, l. c.
[45] Botanical Tracts, by Hill, Tab. VII. fig. 4.
[46] Speciosissimum exemplar, quod Schimper prope Monachiam invenit, quod hâc multisque aliis abnormitatibus abundat.
[47] De Cand. Organogr., Tab. XLVII.
[48] Schimper in der bot. Zeitg. 1829, pag. 440.
[49] In floribus, quorum corolla paulo amplificata est, stamina petaloidea inveni.
[50] Bydragen tot de Nat. Wetensch., II. pag. 226.
[51] Ab amicissimo A. Mayer prope Brückenau collectum exemplar; singula ex staminibus orta petala non connata erant.
[52] Tab. III. fig. 10 et 12.
[53] Jäger, Missbild., pag. 109.
[54] Weinmann, Phytanth. iconogr. Nro. 609, e.
[55] Cf. Tab. III. fig. 9.
[56] De Candolle Organogr., Tab. XLVII.
[57] Tab. III. fig. 9.

Dauco Carotâ (cujus forma talis maturat fructus petalis persistentibus), *Rosâ*,[58] *Pyro Malo*,[59] pluribus *Caryophylleis*,[60] *Dictamno albo*,[61] *Thlaspi Bursâ pastoris*.

h. *Regressus Foliorum Perigonialium in Folia Subfloralia vel Folia Vegetationis.* [30]

34. Interdum in *Tulipâ* obviam est; inter Dicotyledoneas in *Calthâ palustri*, *Anemone nemorosâ*,[62] *A. ranunculoide*,[63] *A. hortensi*;[64] in *Anemone Pulsatillâ*[65] folia perigonialia virescunt nec diffinduntur in foliorum involucralium modum.

i. *Regressus Foliorum Calycinorum in Folia Subfloralia vel Folia Vegetationis.*

35. Hic regressus, quem etiam frondescentiam dicere possumus, frequenter occurrit, saepe cum aliis antholysis formis conjunctus, quales sunt disjunctio, apostasis, etc. Exempla, quae aut ipse observavi, aut ex scriptis laudatis hausi, inveniuntur in *Primulâ elatiore*,[66] *Convolvulo Sepium*,[67] *Gentianâ campestri*;[68] huc pappi in folia vera mutatio in *Scorzonerâ octangulari*[69] et *Senecione vulgari*.[70] Regressus calycis porro apparet in *Campanulâ*,[71] *Athamantâ Cervariâ*,[72] multis *Rosaceis*, inprimis *Rosâ*,[73] *Ceraso*,[74] *Amygdalo*,[75] egregie in *Geo rivali*,[76] nec non in *Fragariâ*; [31] in *Caryophylleis* plerumque cum apostasi, in *Thlaspi arvensi*, cujus sepala persistentia fiunt; in *Cheiranthо Cheiri* et *incano*. Bracteae *Papaveris orientalis bracteati* sepala sunt retrograda; *Ranunculus* denique foliis calycinis virescentibus dissectisque occurrit.

k. *Regressus totius Floris ex Formâ Irregulari in Regularem.*

36. Flores normaliter irregulares interdum in antholysim tendentes normales fiunt, et tum *peloriae* dicuntur. Actione naturae magis liberâ normae talium florum intimae manifestius apparent, et ex involutione aliis conditionibus effectâ prodeunt, quo regularis cuique flori innata structura exhibetur. Evolutio partium normaliter abortientum, quâ *De Candolle* peloriarum formationem explicit, non causa ejus sed potius sequela est.

Pelorias invenerunt in *Orchide*, multis *Personatis* nonnullis *Labiatis*, *Violâ*, *Medicagine*, *Aconito*, aliis.

Simillimum formationi peloriarum id est, quod in floribus folia pistillaria, quae numero haud respondent ceterorum verticillorum foliis, isomeres fiant, et totius floris regularitatem perficiant. *Campanula*,[77] *Medicago*, *Mimosa*,[78] *Cerasus*,[79] *Amygdalus*,[80] *Dianthus*,[81] multaeque [32] aliae plantae hujus abnormitatis regularis exempla offerunt.

l. *Appendix. Integrorum Ortus Florum ex Foliis Pollinaribus mutatis.*

37. Singularis haec evolutio in *Alceâ roseâ* observari licet. Jam supra vidimus, ex columnâ staminum novos fieri axes staminibus et petalis instructos. Porro in novi hujus pedunculi cacu-

[58] Cf. e. g. Tab. III. fig. 3.
[59] Morgenblatt 1829, Nro. 253. Prope Carlsruhe similis arbor fuit (A. Braun); in amborum floribus simul stamina 15 externa in carpia erant mutata metamorphosi abnormem in modum progrediente.
[60] Bot. Zeitung, 1829, pag. 437.
[61] Flore française, Tom. IV. pag. 734.
[62] Clus. rar. plant. hist., II. pag. 247.
[63] Tab. I. fig. 2.
[64] Weinmann, Phyt. ic. Nro. 123, c.
[65] L. c. Nro. 839, c. et d.
[66] L. c. Nro. 832, b., et Botan. Zeitg. 1831, pag. 8.
[67] Tab. I. fig. 3.
[68] Tab. I. fig. 1.
[69] De Cand. Organogr., Tab. XXXII. fig. 6.
[70] Tab. V. fig. 24-26.
[71] Tab. III. fig. 15 et 16; Linnaea, I. pag. 454; Weinm. Phyt. ic. Nro. 294.
[72] Tab. V. fig. 14.
[73] Tab. III. fig. 3.
[74] Jäger, Missbild., pag. 57.
[75] Weinm. Phyt. ic. Nro. 102, b.
[76] Hoc est Anemone dodecaphylla Krock. Flor. Siles., II. pag. 235, Tab. XX.
[77] Tab. III. fig. 10 et 15.
[78] De Cand. Organograph.
[79] De Cand. jard. de Genève, Tab. XVIII.
[80] Tab. I. fig. 4, ubi autem quatuor tantum carpia adsunt; alias quinque occurrunt.
[81] Jäger, Missbild., pag. 142.

mine interdum carpiorum verticillus oritur, circum quem stamina et petala arctius componuntur; petala exteriora mutantur in sepala, quae cetera circumdant involvuntque. Haec sepala sensim abeunt in petala ad columnam floris primarii androeceam pertinentia.[82] Proliferationis modus dici potest haec abnormitas, multo autem differt ratione evolutionis ab iis, qui infra exponendi sunt.

2. Virescentia.

38. Virescentia floris (Vergrünung) ea mutatio est, quâ omnia vel plurima ejus organa colorem viridem et texturam firmiorem acquirunt, frequenter quoque re verâ in modum foliorum vegetationis expanduntur. Saepe duos virescentiae modos distinguere licet: 1, solam virescentiam formâ organorum primitivâ plus minusve servatâ, virescentiam sensu strictiore; et 2, virescentiam, quâ organa, servatâ collocatione alioque ad florem respectu, foliis vegetationis simillima fiunt, frondescentiam (Verlaubung). Haud ubique talem virescentiae divisionem, quae diversos tantum ejusdem mutationis gradus indicare videtur, possumus adhibere.

Virescentia multo magis quam regressus floribus nocet; raro tantum semina maturare permittit; vera monstra efficit.

Singulorum floris organorum virescentia huc referri potest; foliorum vero corollinorum [33] atque calycinorum virescentia majore jure supra tractata est, et foliorum pistillarium virescentia, cum semper cum disjunctione conspiciatur, infra commemorabitur.

39. Flores virescentes reperiuntur in *Colchico autumnali*;[83] folia perigonialia viridia erant aeque ac stamina et pistilla, quae polline ovulisque carebant. In *Euphorbiâ stellulatâ Röper*[84] ramulum bifolium vidit, florem nempe masculum virescentem; quod etiam in *Euphorbiâ cyparissiâ* observavi. *Anagallis phoenicea*[85] autumno saepe cum floribus viridibus occurrit. Virescentiam *Stachyis silvaticae* et *Symphyti officinalis Schimper* vidit et depinxit;[86] illius calyx gamosepalus remanebat, hujus autem in 5 folia majora mutatus erat; corollae et stamina firma, viridia; pistilla mirum in modum mutata, de quibus infra fusius disserendum.

Eximias maximeque varias virescentiae formas in *Giliâ glomeriflorâ* animadverti; calyx plerumque auctus, tubulosus vel in quinque folia disjunctus corollam parvam viridem circumdat, cujus folia interdum pinnatifida fiunt; filamenta herbacea parvas antheras virides sustinent; germen amplificatum saepe in folia lanceolata vel pinnatifida dividitur.[87] *Gentianae amarellae* virescentiam *Alex. Braun* et *Lonicerae Xylostei Jäger*[88] viderunt. [34]

Cassini[89] *Scabiosam columbariam* describit, in cujus floribus viridibus filamenta foliola viridia ferebant. Alium virescentiae modum amic. *Avé-Lallemant*[90] in *Scabiosâ agresti* observavit; calycis externi et interni folia majora et dissecta erant, nec non stipite separata; corolla cum staminibus parva, viridis; pistillum paene abolitum.

In *Senecione vulgari* egregiam seriem flosculorum vidi a normalibus usque ad plane virides, quorum paucos Tab. V. fig. 23–26 exhibui. Similem abnormitatem *Cassini*[91] observavit in *Cirsio tricephalode*; nec non *Calendula* Tab. V. fig. 28 depicta cum illis congruit.

Campanulae rapunculoidis flores virescentes haud rari sunt;[92] interdum intra folia pistillaria frondescentia et aperta oriuntur nova folia,[93] quâ ratione denique densus foliorum fasciculus provenit,[94] cujus autem evolutio etiam formationis impedimento explicari potest.

[82] Tab. I. fig. 6 et 7.
[83] Römer's Archiv für d. Bot., Bd. II. Stück 2, pag. 233.
[84] Enum. Euphorb., pag. 42.
[85] Tab. I. fig. 9 et 10; Tab. II. fig. 1.
[86] Geiger's Magaz. für Pharmacie 1830, Jan., Tab. IV. et V. Quod descriptio iconum deest, valde dolendum est; eaedem sunt icones, quas Schimper in conventu naturae studiosorum Heidelbergae 1829 protulit. Symphytum tale etiam in herbario Societ. naturae scrut. Senkenb. servatur.
[87] Tab. II. fig. 8–14.
[88] Missbild., pag. 62.
[89] Opusc. phytolog., II. pag. 549.
[90] De Plantis quibusdam Ital. bor. etc. Dissert. inaugur. Berolini 1829, pag. 8 et 9, fig. 5–12.
[91] Journ. de Phys., Tom. LXXXIX. pag. 401.
[92] Tab. III. fig. 13.
[93] Linnaea, I. 454.
[94] Tab. III. fig. 15 et 16.

40. Speciosum florum virescentium ordinem in *Torili Anthrisco*[95] animadverti: flores plerumque simul hypogyni fiebant. Antherae mutatae erant in folia petiolata (rarius sessilia, fig. 8) rotunda, tetraptera aut plana, interdum incisa (fig. 6 et 8), folia pistillaria disjuncta erant et una cum foliis calycinis amplificatione nimiâ foliorum pollinarium repressa, quod si secus [35] eveniebat, magna et lata erant (fig. 3), aut angusta et crassa ex margine 2–4 folia, quae semina involverant, edebant (fig. 4–5). Etiam in *Dauco Carotâ* et *Heracleo Sphondylio* virescentia occurrit.

Trifolii repentis flores virides saepius observati sunt, quorum *Jaeger*,[96] *De Candolle*,[97] et *Schimper*[98] icones ederunt. In capite de disjunctione latius de his mutationibus loquemur.

Rubum calycis foliis petiolatis aculeatis, foliis corollinis viridibus, viridibusque et caudatis carpiis *Spenner* describit.[99]

Virescentem *Lychnidem silvestrem* et *Alsinen mediam* observavit *A. Braun*.

Reseda lutea et *R. Phyteuma* abnormitatibus inveniuntur huc pertinentibus, de quibus infra.

Dictamnus albus[100] aliquoties occurrit sepalis et petalis viridibus, staminibus viridibus rubescentibus, antheris haud dehiscentibus vel in viridia folia tetraptera mutatis; folia pistillaria aperta, plerumque expansa.

Tropaeolum majus interdum cum magis minusve perfectâ florum virescentiâ conspicitur.[101] *Jaeger* sepala vidit disjuncta, petala viridia, petiolata, spatulata vel peltata; stamina plerumque abolita; ovarium amplificatum apice hians; vel stamina mutata in folia viridia, hastata, pistillum autem debilitatum, minimum.

41. *Cruciferae* saepius flores herbaceos praebent. Tab. IV. fig. 3–20 icones partium [36] *Erysimi officinalis* exhibent. Petala saepe desunt; sepala majora, folia pollinaria plerumque magna, viridia, foliis caulinis calycinibusve similia, vel tetraptera, vel paululum tantum mutata, sed viridia, sine polline; folia pistillaria saepe desiderantur, vel multipliciter transformata sunt, quae infra tractabuntur. *Erysimum cheiranthoides*[102] et *E. Barbarea*, *Alyssum incanum*, *Peltaria alliacea*, et *Raphanus sativus*,[103] nec non *Turritis glabra*[104] similem in modum abnormes observati sunt. *Uredine candidâ* flores interdum virescunt, quod in *Sisymbrio tenuifolio* et *Thlaspi Bursâ pastoris* vidi. *Hesperis matronalis* cum floribus plenis herbaceis hic inde in hortis deprehenditur.[105]

Flores virescentes *Ranunculaceorum* non tam frequentes sunt. *Delphinium crassicaule* animadvertit *Roeper*[106] cum 5 foliis calycinis et 3 pistillaribus petiolatis dentatis, petalis parvis cucullatis, staminibus minus mutatis. *Delphinium Ajacis* cum plenis floribus viridibus *Weinmann*[107] depinxit. *Aquilegiae vulgaris* exemplar *Jaeger*[108] coluit, cujus folia calycina et corollina (haec calcare destituta) virescebant; folia pistillaria aperta, lobata erant. *Anemone nemorosa* postremo nominanda est, in quâ omnia folia viridia, dissecta, incisa facta erant.[109] Quod in *Anemone hortensi*[110] quoque occurrit.

3. Disjunctio. [37]

42. Disjunctio (Trennung) cum apostasi antholysis sensu strictissimo est, solutio foliorum, quae in flore unita et conjuncta erant. Hic quoque constat, ut in certis quibusdam casibus id, quod in

[95] Tab. V. fig. 1–13.
[96] Missb., pag. 83, fig. 8–10.
[97] Organograph., Tab. XXVIII. fig. 1.
[98] Mag. f. Pharm. 1830, Jan., Tab. V. fig. 87–97, et Tab. VI. fig. 1–9.
[99] Fl. Friburg., pag. 744.
[100] Marchand in Mém. Acad. des Sciences 1693, pag. 23; et Eysenhardt in Linnaeâ, I. pag. 577, cum Tab. VII.
[101] Richard, Grundriss der Bot., pag. 278. Weinmann, Phyt., ic. Nro. 753, d. Nov. act. Leop., Vol. X. pag. 811, cum tabulâ.
[102] Bydragen tot de Nat. Wet., II. pag. 226.
[103] Bot. Zeitg. 1829, pag. 434.
[104] Richard, Grundriss der Bot., pag. 246.
[105] Weinmann, Phyt., ic. Nro. 572, a.
[106] Enum. Euphorb., pag. 45 in notâ.
[107] Phyt., ic. Nro. 409.
[108] Missb., pag. 78, fig. 4–7.
[109] De Cand. Organogr., Tab. XXXV. Isis von Oken, 1818, pag. 1003.
[110] Weinm., Phyt., ic. Nro. 122, d.

aliis altior gradus esse appareat, inferior sit. Calyces et corollas eleutheromeres (partibus liberis) altioris gradus evolutiones esse habemus, quam gamomeres (partibus connatis), et in plantis, quas summas arbitramur in regno vegetabili, videmus. Attamen hic disjunctionem calycum corollarumque gamomerium metamorphosis retrogradae formationibus adnumerare debemus; apostaseos initium esse, elucebit.

a. *Disjunctio Foliorum Pistillarium.*

43. Haec disjunctio in plurimis floribus virescentibus obviam est, sed sola quoque invenitur. Diversos gradus distinguere possumus. 1. Carpia in uno conjuncta ovario separantur, sed singula remanent clausa. 2. Ovarium clausum est, interne autem quae antea conjuncta erant sejunguntur, dissepimenta abolescunt. 3. Folia pistillaria frondescunt, disjunguntur, interdum in margine ovula retinent monstrosa, saepe manent stigmate coronata; postremo etiam haec signa functionis prioris evanescunt, et folia plana viridia aut colorata adsunt.

44. Magni momenti ovulorum commutatio est, sed hucusque plane praetermiserunt eam, usque amic. *C. Schimper* primus accuratissime sagacissimeque eam investigaverit. Embryonis tegumenta, in quae cl. *R. Brown* diligentissime inquisivit, haud clauduntur, uti in normali evolutione fit, sed in foliola convoluta mutantur, ex quibus saepe vestigia embryonis prominent; postremo folium externum planum fit et expansum, et omnia, quae sequuntur, abolescunt, vel [38] interdum rudimenta formâ stipitis remanent; folium ipsum sessile aut funiculo umbilicali suffultum in margine folii pistillaris collocatum est, vel plane concrescit cum hoc et lobos dentesve efficit. Secundum nonnullas observationes a vero non multum abesse mihi videor contendendo, loco seminum veras evolvi gemmas floriferas vel foliiferas; quam ad evolutionem transitus apparet in seminibus quarumdam *Liliacearum* interdum in bulbillos conversis.

45. Sola disjunctio carpiorum clausorum adest in *malis aurantiis* et *citreis*, quae cornuta vocantur; etiam in *Athamantâ Cervariâ* eam vidi.[111]

Disjunctio interna ovariorum externe clausorum eversis dissepimentis optime conspicitur in *Stachyis silvaticae* [112] et *Symphyti officinalis* floribus virescentibus. Folia pistillaria manifeste duo apparent, et duo constituunt loculamenta, interdum nonnisi unum. Simile quid vidi in *Giliâ glomeriflorâ* [113] et *Erysimo officinali*.[114]

Apertura ipsa ovarii in *Graminibus* nonnunquam reperitur, ambobus foliis pistillaribus disjunctis auctisque. *Gramina* ejusmodi abnormia saepe vivipara dicuntur, uti omnia, quae virescentiâ foliorum floralium subfloraliumque commutata sunt. Manifestissimam vidi disjunctionem in *Phleo Böhmeri*, nec non in *Phleo pratensi* aliisque.

In cultis *Liliaceis*, praesertim *Tulipis*, saepius obviam est.

Primulam acaulem,[115] *Stachyem silvaticam*,[116] *Symphytum officinale* [117] *Schimper* obser- [39] vavit cum ovariis apertis; qui similem quoque metamorphosin in *Orabanche gracili* invenit. In *Anagallide phoeniceâ* disjunctionem foliorum pistillarium et in uno hujus plantae flore diruptionem ovarii protrudentibus ramulis foliisque loco seminum evolutis animadverti.[118]

Diversos disjunctionis gradus et mutationis ovulorum in *Giliâ glomeriflorâ* Tab. II. fig. 11–13 et 16–18 adspicere licet. *Gentiana campestris* [119] et *Campanula rapunculoides* [120] similem in modum disjunctae occurrunt.

46. *Umbelliferis* haec antholysis haud insolita. Quam praesertim vidi in *Torili Anthrisco*; [121] folia pistillaria aucta sunt, lata, ovulis destituta; vel linearia, canaliculata sunt et in margine pro-

[111] Tab. V. fig. 17.
[112] Schimper in Geig. Mag. f. Pharm. 1830, Jan., Tab. IV. fig. 46–53.
[113] Tab. II. fig. 10 et 17.
[114] Tab. IV. fig. 3.
[115] Spenn. Fl. Frib., pag. 1061.
[116] Mag. f. Pharm. 1830, Jan., Tab. IV. fig. 20–24.
[117] L. c., fig. 17 et 19.
[118] Tab. II. fig. 2–5.
[119] Roeper in Linnaeâ, I. pag. 457.
[120] Tab. III. fig. 13 et 15.
[121] Tab. V. fig. 1–6.

ferunt embryonum tegumenta expansa in folia et amplificata. Huc etiam *Daucus Carota*, *Heracleum Sphondylium*, *Angelica silvestris* referenda.[122]

Trifolium repens cum legumine aperto *Jaeger*[123] et egregie *Schimper* depinxit;[124] folia ovulorum fiunt pinnae folii pistillaris. *Lathyri latifolii* mentionem facit *De Candolle*[125] legumine in folium planum mutato instructi.

Rosarum carpia interdum aperiuntur, et folia tomentosa vel viridia vel partim rubescentia fiunt. *Amygdalus persica*[126] et *Prunus Cerasus*[127] saepius in floribus plenis aperturam et frondescentiam carpiorum numero auctorum ostendunt. [40]

Dianthi caryophylli ovarium incipiente diaphysi plerumque aperitur; in *Resedâ* saepius idem apparebat; *R. luteae* icones *Schimper* praebet[128] ovariis amplificatis apertis et ovulis vario modo mutatis. *Dictamnum* et *Tropaeolum* de virescentiâ disserens jam descripsi.

Pistilla *Cruciferarum* aperta vidi in *Brassicâ oleraceâ*,[129] *Cheiranthо Cheiri* et *Erysimo officinali*;[130] in illis siliqua uno latere hiscebat, in hoc autem folia pistillaria disjuncta erant, frondescentia, integra vel ovulis dentata. *Erysimum Barbarea*, *Alyssum incanum* et *Peltaria alliacea*,[131] nec non *Cardamine pratensis*[132] simili modo transformatae observatae sunt.

Paeonia et *Delphinium Ajacis*[133] folia pistillaria plana petaloidea ostendunt in floribus plenis. *Delphinium crassicaule Roeper*[134] describit cum carpiis apertis viridibus, in margine foliolis loco ovulorum instructis. Simile quid in *Aquilegiâ vulgari Jaeger*[135] observavit.

b. *Disjunctio Petalorum Gamomerium.*

47. Haec antholysis forma non frequenter occurrit; quam vidi in *Anagallide*[136] virescente; in *Orobanche Schimper* animadvertit. Nominantur ab auctoribus *Solanum tuberosum*,[137] *Convolvulus arvensis*,[138] *Phlox amoena*,[139] *Rhodora Canadensis*,[140] *Azalea periclymena*,[141] postremo *Campanula Medium*.[142] [41]

Disjunctio foliorum perigonialium gamomerium in *Convallariâ majali* obviam est, plerumque una cum apostasi et ecblastesi.

c. *Disjunctio Sepalorum Gamomerium.*

48. Disjunctio sepalorum vel sola invenitur, vel juncta cum calycis frondescentiâ. Huc referri debet disjunctio calycis epigyni ab ovario, cum flos normaliter epigynus fiat hypogynus.

Foliorum calycinorum disjunctio in *Primulâ elatiore*,[143] *Symphyto officinali* virescente, *Gentianâ campestri*[144] reperitur; in *Rosis* saepius alias abnormibus, rarius sola;[145] in *Caryophylleis* una cum apostasi.

Calyx superus fit hypogynus in *Campanulâ persicifoliâ*,[146] *Torili Anthrisco*,[147] *Athamantâ Cervariâ*,[148] *Dauco Carotâ*[149] aliisque *Umbelliferis*.

[122] Mag. f. Pharm. Jan. 1830, Tab. VI. fig. 10 sqq., et A. Braun in litt.
[123] Missb., pag. 83, fig. 9.
[124] Mag. f. Pharm. Jan. 1830, Tab. V. fig. 89, 96, et 98; Tab. VI. fig. 1–9.
[125] Mém. Légum., Tab. II. fig. 1–2.
[126] Tab. I. fig. 4–5.
[127] Linnaea, V. 175.
[128] Mag. f. Pharm. Jan. 1831, Tab. V. fig. 39 sqq.
[129] Tab. IV. fig. 2.
[130] L. c., fig. 4–20.
[131] Bot. Zeitg. 1829, pag. 434.
[132] Spenner, Fl. Friburg., pag. 921, nota.
[133] Schultz, Nat. d. leb. Pflanze, II. pag. 110.
[134] Enum. Euphorb., pag. 45 in notâ.
[135] Missb., pag. 78, fig. 4–7.
[136] Tab. I. fig. 9 et 10; Tab. II. figs. 1, 6, et 7.
[137] Bot. Zeitg. 1829, pag. 714.
[138] Hopkirk, Flora anomala. Glasgow, 1817.
[139] De Candolle Organogr., Tab. XLII. fig. 5.
[140] L. c., fig. 2.
[141] Hopkirk, l. c.
[142] De Cand. Org., Tab. XLII. fig. 1.
[143] Weinm., Phyt., ic. Nro. 832, e.
[144] Tab. I. fig. 1.
[145] Tab. III. fig. 1 et 3.
[146] L. c., fig. 9.
[147] Tab. V. fig. 1–3 sqq.
[148] L. c., fig. 15–17.
[149] Mag. f. Pharm. 1830, Jan., Tab. VI. fig. 10.

II. ANTHOLYSES, QUIBUS FLORIS AXIS NECESSARIO MUTATUR. [42]

1. Apostasis.

49. Apostasis foliorum floralium (Auseinanderheben), evolutione interfoliorum in flore normali suppressorum effecta, disjunctionis altior gradus dici potest. Positione in caule obliquâ incipit apostasis; alter folii margo in verticillo ceterorum locum tenet, alter removetur. Distinguere possumus apostasin verticillorum integrorum et apostasin singulorum foliorum; porro apostasin in externis et in internis foliis floralibus. Apostasis singulorum foliorum et quidem exteriorum multo saepius occurrit; haec folia, caulinis proxima, facilius a flore separantur.

50. Exteriorum foliorum floralium apostasis obviam est in *Convallariâ majali* et *Tulipâ Gesneriânâ* cultis *Anagallidis phoeniceae* calycem totum a corollâ remotum vidi;[150] *Veronica Chamaedrys* apostasi una cum ecblastesi mutatur. Integrum calycem singulaque folia calycina apostatica *Schimper* in *Orobanche gracili* observavit. *Solanum Lycopersicum*[151] et *Gentiana campestris*[152] cum unius sepali apostasi nec non ecblastesi inveniuntur. *Torilis Anthrisci* totius calycis et singulorum sepalorum apostasim depinxi Tab. X. fig. 11 et 12, a. *Rosa* saepius profert sepalum in medio tubo calycino. *A. Braun* in *Hyperico* apostasim sepali vidit, nec non in *Helleboro foetido* una cum frondescentiâ; *Calthae palustris* exempla multa in ejus herbario conspexi cum apostasi vel obliquitate singuli folii perigonialis. Dispersionem omnium sepalorum et [43] apostasim singulorum verticillorum dimerium in *Brassicâ oleraceâ* observavi.

51. Apostasis foliorum floralium internorum saepius obviam est in floribus plenis diaphysim incipiens; inprimis in *Tulipâ,* multis *Rosaceis, Caryophylleis, Cruciferis, Ranunculaceis.*[153] Porro invenitur cum verâ diaphysi ita, ut in novo axe intima folia floralia attollantur; e. g. folia virescentia vel rubescentia ex carpiis staminibusve orta *Rosarum;* in *Gei rivalis* exemplo in herbario *societ. nat. scrut. Senkenbergianae* nonnulla stamina, quae non mutata esse videntur, in axe continuato collocata sunt. Postremo tertius hujus abnormitatis modus is est, quo stamina et pistilla vel pistilla sola in axe elongato evehuntur; illud in *Geo rivali,*[154] hoc in *Cerasis,*[155] *Dictamno*[156] et *Cardamine*[157] observatum est.

2. Diaphysis.

52. Diaphysis (Durchwachsung) continuatione axis floralis per florem efficitur, elongatione pedunculi, qui receptaculo terminatus erat, et novorum organorum in eo procreatione. Cum ecblastesi confundebatur diaphysis, quamvis jam *Göthe* in libello de plantarum metamorphosi eas stricte distinxisset nominibus *Durchwuchs* et *Ueberwuchs.*

Diaphysis triplici modo fieri potest. 1. Intimae floris partes mutatae attolluntur apostasi, amplificantur, novo integumento involvuntur et postremo plus minusve perfectos [44] flores secundarios exhibent. Id quod obviam est in *Liliaceis, Rosaceis, Caryophylleis, Cruciferis, Ranunculaceis.* 2. Folia pistillaria aperiuntur et calycis loco circumdant novum florem, qui petalis imperfectis tantum et convolutis significatur, vel plane excultus perficitur; in *Rosaceis, Caryophylleis, Rutaceis.* 3. Ultimus idemque perfectissimus diaphysis gradus is est, quo in caulis fine intra folia pistillaria oritur nova gemma, ex quâ, cum axis elongetur, ramus foliosus vel inflorescentia vel flos evolvitur. Quod inveniebant in *Polygoneis, Personatis, Labiatis, Asperifoliis, Gentianeis, Compositis, Umbelliferis, Rosaceis, Caryophylleis, Rutaceis, Cruciferis, Ranunculaceis.*

Flos secundarius saepe iterum antholyticus est, praesertim novâ laborat diaphysi.

53. In *Phleo pratensi* inter disjuncta folia pistillaria perfectum culmum exire vidi. Primus et

[150] Tab. II. fig. 6 et 7.
[151] Linnaea, I. 458.
[152] Tab. I. fig. 1.
[153] Jäger, Missbild., pag. 132 sqq.
[154] Bot. Zeitg. 1831, pag. 230.
[155] Linnaea, V. pag. 175.
[156] L. c., I. pag. 584.
[157] Spenner, Fl. Frib., pag. 921 in notâ.

secundus diaphysis modus occurrit in *Tulipâ*;[158] in *Ranice arifolio*[159] singuli flores, in *Anagallide phoniceâ*[160] foliosi rami, in *Orobanche gracili* (*Schimper*) racemi laete florentes procreverunt ex floribus primariis. In *Stachye silvaticâ*[161] *Schimper* novos flores, iterum diaphytos, in *Symphyto officinali*[162] autem totas inflorescentias ex florum viridium disjunctis foliis pistillaribus provenisse vidit; nec non de *Gentianâ acauli* loquens, ex cujus floribus virescentibus turiones foliosi protrudebantur, iterum ad eundem certissimum auctorem et diligentissimum sagacissi- [45] mumque observatorem provocandum mihi est.[163]

In *Hieracio fallace* ramulum dense foliosum ex fructu maturescente evolutum vidi.[164] Diaphysin *Cirsii tricephalodis Cassini*[165] describit; stigmata styli viridis foliacea ut bracteae calathidem novam includebant; nec minus ipse vidi in *Calendulâ* et *Senecione* ex singulo flosculo totum receptaculum, flosculorum vestigiis notatum, evehi.[166]

54. Nonnullae *Umbelliferae* diaphysi mutantur; *Athamanta Cervaria*[167] et *Daucus Carota* sine aliâ floris abnormitate; *Torilis Anthriscus*[168] autem cum virescentiâ, in illis singuli flores, in hâc plerumque umbellulae vel umbellae oriuntur. In *Medicagine lupulinâ* inter tria floris primarii carpia secundarium inveni.

Rosaceae multas multiplicesque diaphyses praebent. In ipsâ *Rosâ* ex tubi calycini fundo emergit stipes petala, nonnulla stamina et viridia ex carpiis orta folia proferens;[169] vel tubus calycinus evanescit et axis cum foliis ex staminibus carpiisque ortis elongatur, quae supra in novum colliguntur florem;[170] vel caulis novum florem completum profert, vel folia vegetationis pinnata, pluresque interdum flores; omnes antholysis formae adhuc perlustratae una inveniuntur. Singularem abnormitatem *Rosarum* hic nominabo tantum, cum infra latius describatur; alabastra nempe ad internum tubi calycini marginem orta,[171] id quod diaphysis dici non potest, quippe [46] quae semper centralis est, ad quam autem fig. 7 transitum ostendere videtur. In *Amygdalo persicâ* diaphysis ita fit, ut ex carpiis numero auctis calyx novi floris formetur; similia in *Amygdalo humili* et *Pruno Ceraso*[172] observantur, sed flos secundarius ibi sessilis hic pedunculo squamoso elatus est. *Pyra* quoque, ex quibus novi flores et fructus gignuntur,[173] hic nominanda sunt. *Rubi* diaphysin *Spenner*[174] exponit, et in *Geo rivali* ea saepius reperitur;[175] folia floris primarii calycina saepe frondescunt et in flore secundario petalis mutatis supplentur.

55. Inter *Caryophylleas* diaphysis inprimis in *Diantho caryophyllo* culto occurrit; interdum oriuntur in ovariis inapertis nova alabastra,[176] vel ovarium apertum constituit novi floris calycem, vel prorsus novus flos oritur,[177] et nonnunquam tertius flos ex secundo procrescit. In *Sileno*[178] et *Lychnide Flore cuculi*[179] diaphysis invenitur. Cujus vestigia interdum in *Caryophyllearum* floribus plenissimis adsunt.

Diaphysin ter quaterque repetitam *Resedae luteae* describit *Schimper*[180] orientem antequam ovarium aperiatur.

Omnes diaphysis modos supra commemoratos *Eysenhardt* in *Dictamno albo* obser- [47] vavit.[181]

[158] Jäger, Missbild., pag. 130. Linnaea, I. 595.
[159] Bot. Zeitg. 1829, pag. 440.
[160] Tab. II. fig. 7.
[161] Mag. f. Pharm. 1830, Jan., Tab. IV. fig. 25–28.
[162] L. c., fig. 17 et 19.
[163] Bot. Zeitg. 1829, pag. 440.
[164] Tab. V. fig. 24.
[165] Journ. de Phys., Tom. LXXXIX. pag. 401.
[166] Tab. V. fig. 26–28.
[167] L. c., fig. 18–20.
[168] L. c., fig. 13.
[169] Tab. III. fig. 2.
[170] L. c., fig. 3.
[171] L. c., fig. 4–7.
[172] Jäger, Missbild., pag. 152.
[173] Bonnet, Recherches sur l'usage des feuilles 1754, Mém. IV. Pl. XXVI. fig. 1–2.
[174] Fl. Frib., pag. 744.
[175] Breynii, Exot. cent. I. Tab. LX. Hill, Prolif. Flowers, Tab. IV. Bot. Zeitg. 1831, pag. 230, etc. Ipse quoque eam saepius vidi.
[176] Bot. Zeitg. 1829, p. 437.
[177] Jäger, Missbild., pag. 144. Weinm., Phyt. ic., Nro. 336, etc. Hill, Prolif. Flowers, Tab. VI.
[178] Weinm., Phyt. ic., Nro. 680, d.
[179] Jäger, Missbild., pag. 142.
[180] Bot. Zeitg. 1829, pag. 438.
[181] Linnaea, I. pag. 584.

Cruciferae duas hujus metamorphosis rationes praebent; alteram videmus in floribus plenis *Siliquosarum*; in axe elongato incompleti flores proveniunt, petalorum coronae interdum nonnullis staminibus praeditae.[182] Altera ratio in floribus virescentibus obviam est, nonnisi inflorescentiae evadunt, nunquam singulos flores observavi. In *Erysimo officinali*[183] totum hujus antholysis progressum vidi. In fundo pistilli clausi sed amplificati nova folia procreantur, quae serius majora facta dirumpunt tegumenta; vel folia pistillaria prius disjunguntur et folia nova laete excrescunt; alias folia pistillaria in novo axe tolluntur quasi cotyledones inflorescentiae inter ea enatae. Praeterea in *Erysimo cheiranthoide*,[184] *E. barbareâ*, *Alysso incano* et *Peltariâ alliaceâ*[185] talem mutationem invenerunt perscrutatores. In *Brassicâ Napo* ex flore minus abnormi, solo pistillo carente, racemum florum normalium provenisse vidi.

Inter *Ranunculaceas* in cultarum *Calthae palustris* et *Ranunculi acris*,[186] *R. asiatici* et *Anemones hortensis*[187] floribus plenis plus minusve perfecta diaphysis reperitur; praeterea in *Anemones ranunculoidis* exemplo in Tauno monte ab humanissimo *J. Becker* collecto[188] completum florem secundarium conspicere licet.

3. Ecblastesis. [48]

56. Gemmarum apparitio intra florem, in axillis foliorum floralium, quae proliferatio proprie sic dicta est (Sprosszeugung), hic autem propter hujus nominis confusionem ecblastesis (Aussprossen) nominatur, summus antholysis gradus est. Folia floralia in hâc antholysi minus ad propagationem per semina respiciunt, sed ratione foliorum vegetationis gemmas proferunt. Ex his gemmis evolvuntur vel flores vel inflorescentiae vel rami foliosi.

a. *Ecblastesis Foliorum Calycinorum.*

57. Folia calycina, vegetationis foliis maxime affinia, saepe iis gemmarum quoque procreatione similia fiunt; et in omnibus formis foliorum calycinorum ceterum normalibus, et in abnormibus, virescentibus, disjunctis, apostaticis observare licet ecblastesin.

Exempla profero *Rumicem obtusifolium*,[189] *Veronicam Chamedryem* (*A. Braun*), ex cujus singulis floribus totus evolvebatur racemus; *Solanum Lycopersicum*,[190] *Gentianam campestrem*,[191] *Campanulam rapunculoidem*.[192]

Varios ecblastesis modos *Umbelliferae* praebent, quorum nonnulli in Tab. V. depicti sunt. In *Athamantâ Cervariâ*[193] flos praeterea vix mutatus est, nonnisi sepala quaedam interdum aucta sunt, interdum simul hypogyna. Similia observavi in *Dauco Carotâ*, *Bupleuro falcato*,
Torili Anthrisco et *Schimper*[194] in *Apio graveolente*, *Pastinacâ officinali*, *Heracleo Sphondylio*, [49]
Angelicâ silvestri. In virescentibus *Torilis Anthrisci* floribus plerumque totae umbellae ex sepalorum axillis procreantur; folia pollinaria simul diminuuntur et saepe abolescunt.[195]

Inter *Leguminosas Schimper*[196] saepius invenit ecblastesin foliorum calycinorum e. g. in *Meliloto leucanthâ*, *Coronillâ variâ*, *Medicagine sativâ* et *lupulinâ*, in quâ idem ipse quoque vidi.

Caryophylleae haud raro in axillis sepalorum frondescentium et apostaticorum ramos gignunt ratione illius *Gentianae* simillimâ. Exempla viderunt *Alex. Braun*, *Schimper*,[197] nonnulla ipse quoque in *Arenaria trinerviâ*, *Agrostemmâ Githagine*, *Lychnide Flore cuculi*, *L. silvestri*, *Stellariâ*

[182] Jäger, Missbild., pag. 135, fig. 21.
[183] Cf. Tab. IV. fig. 5, 6 et 7.
[184] Bydragen tot de Nat. Wetensch., II. pag. 226.
[185] Schimper in Bot. Zeitg. 1829, pag. 434.
[186] Jäger, Missbild., pag. 133.
[187] Hill, Prolif. Flowers, Tab I.–III.
[188] Tab. I. fig. 2.
[189] Schimper in der Bot. Zeitg. 1829, pag. 421.
[190] Linnaea, Tom. I. pag. 458.
[191] Tab. I. fig. 1.
[192] Tab. III. fig. 15–16.
[193] Tab. V. fig. 14–17, et 21.
[194] Bot. Zeitg. 1829, pag. 425.
[195] Tab. V. fig. 12.
[196] Bot. Zeitg. 1829, pag. 421.
[197] L. c.

glaucâ, compluribus *Silenis* et *Gypsophilis*. Plane alia est ecblastesis in *Diantho caryophyllo* hortorum, ex floribus plenis procreantur intra calycem minus mutatum flores secundarii interdum longe pedunculati.[198]

In *Resedâ luteâ*[199] compluries commemoratâ ex axillis quoque sepalorum flores procrescunt.

Cruciferas saepius cum gemmis sepalorum non mutatorum vel apostaticorum axillaribus vidi, e. g. *Brassicam oleraceam*,[200] *Erysimum officinale*, *Cheiranthum Cheiri*; *De Candolle* describit[201] *Cardaminen hirsutam*, quae verisimiliter cum *Brassicâ* in Tab. IV. fig. 1 delineatâ congruit. [50]

In *Cleome*,[202] *Aconito*,[203] *Delphinio*[204] saepius ecblastesis foliorum calycinorum observata est.

b. *Ecblastesis Foliorum Perigonialium.*

58. Flores axillares ex foliis perigonium constituentibus rariores inveniuntur. Sola, quae afferre mihi licet, exempla sunt *Convallaria majalis*, ubi occurrit cum disjunctione et apostasi, et *Hyacinthus botryoides*, cujus formas speciosissimas *Alex. Braun* prope Monachiam legit; perigonium initio non disjunctum in involucri modum flores cingebat secundarios ex axillis protrusos, folia genitalia evanuerant, tandem elongabatur axis, folia perigonialia disjungebantur, et ut bracteae coeruleae ad basin cujusque pedunculi secundarii collocabantur; tum scapus in racemum terminabatur compositum.

Ex Dicotyledoneis *Caltha palustris*[205] et plures *Clematides*[206] hic nominandae sunt.

c. *Ecblastesis Foliorum Corollinorum.* [51]

59. A pluribus memoratur auctoribus; in virescentibus *Tropaeoli majoris* floribus *Jaeger* et *Nees von Esenbeck*[207] invenerunt gemmas axillares petalorum; quas in *Brassicâ Napo* diaphytâ *Schimper* vidit; et de eâdem antholysi in *Erysimo cheiranthoide* loquitur *Courtois*.[208]

d. *Ecblastesis Foliorum Pollinarium.*

60. Ipse nec hunc nec modo dictum proliferationis modum observavi; ni autem fallor, *Schimper* eum in *Brassicâ Napo* illâ invenit. In scriptis vero semel tantum de hâc ecblastesi mentio fit; *De Candolle*[209] enim narrat, *Choisy* Genevae reperisse in horto botanico *Rosas*, quae ad internum tubi calycini marginem protulerint alabastra in axillis foliorum pollinarium. Omnia autem congruunt indicando, hanc observationem similem esse illi, de quâ statim loquar, nec huc pertinere.

e. *Ecblastesis Foliorum Pistillarium.*

61. Folia pistillaria texturâ jam foliis calycinis magis sunt affinia, et facilius talem in modum in generationis actione mutari videntur, ut in axillis, loco marginum, prolem proferant. Id quod *Eysenhardt*[210] invenit in *Dictamno albo*, nec non ipse vidi in *Brassicâ oleraceâ*.[211]

[198] Göthe, Metam. d. Pflanzen, § 105.
[199] Bot. Zeitg. 1829, pag. 439.
[200] Tab. IV. fig. 1 et 2.
[201] Théorie élémentaire, pag. 122. Quae de explicandâ floris Cruciferarum structurâ De Candolle ibi colligit, minime rei naturae congruunt, flores secundarii certo non procrescebant loco staminum breviorum sed ex axillis sepalorum exteriorum; praeterea haec Cardamine, uti nonnullae aliae Cruciferae saepe tetrandra occurrit. Quam maxime tali explicatione et eâ floris Aconiti (Schultz, Nat. d. lebend. Pflanze, II. pag. 114) et floris papilionacei (Dutrochet in Archiv. gén. de Médecine, Juillet 1831) grandis nostri Göthii, qui adhuc usque varias scientiae disciplinas alto suo ingenio illustrat, sententia probatur, quâ metamorphosis doctrinam nuper multos quidem assecutam esse dicit asseclas, sed multipliciter etiam perperam intelligi, et supra modum finesque extendi (Metam. d. Pfl. mit geschichtl. Nacht. Stuttg. 1831).
[202] Bot. Zeitg. 1829, pag. 421.
[203] L. c. et Schultz, Nat. d. leb. Pfl., II. pag. 114.
[204] A. Braun in litt.
[205] Linnaea, I. 458. Spenner, Fl. Frib., pag. 1030.
[206] Bot. Zeitg. 1829, pag. 421.
[207] Nov. Act. Leop., Vol. XIII. pag. 811.
[208] Bydragen tot de Nat. Wetensch., Deel II. pag. 226.
[209] Organographie, I. pag. 487.
[210] Linnaea, I. pag. 584.
[211] Tab. IV. fig. 2.

Hic quoque illae *Rosae*[212] commemorandae sint, quae, diaphysi sane propinquae, ecblas- [52]
tesi tamen ortae esse videntur. Ad internam tubi calycini superficiem (in receptaculo excavato) vel in margine hujus tubi intra frondescentia minusve mutata, solum sterilia carpia obviam sunt alabastra plus minusve completa; quae, ut magis evolvantur (uti fig. 7 ostendit), fieri potest. Non plane intelligo rationem hujus abnormitatis, ipsam autem esse haud dubitandam certum est.

Adduntur quaedam de Inflorescentiis Antholysi Oriundis.

62. De evolutione inflorescentiarum haud locuturus sum, solum de ortu integrarum inflorescentiarum ex singulorum florum solutione, de processu hujus evolutionis et de discriminibus inflorescentiarum inde elucentibus.

Inflorescentiae plerumque solâ ecblastesi (*Hyacinthus*, *Convallaria*, *Brassica*, Tab. IV. fig. 2) ex floribus oriuntur; quae diaphysi evolvuntur paene liberae sunt a floribus primariis (*Erysimum*, Tab. IV. fig. 6–7); sed etiam ecblastesi cum diaphysi fieri possunt inflorescentiae (*Athamanta*, Tab. V. fig. 21, *Medicago*). Plurimae inter has inflorescentias racemosae[213] sunt sive centripetales sive tales, quae legibus de cujusvis gemmae et rami et floris evolutione communibus obtemperant, et extrinsecus introrsum sive ab imo ad summum evolvuntur. Inflorescentiae cymosae sive centrifugales tum solum fieri possunt, si flos primarius (vel secundarius diaphysi ortus) plus minusve completus remanet, ut inflorescentiae centrum referre possit (*Gentiana*, Tab. I. fig. 1, *Caryophylleae* multae, nec non certo quodam sensu *Convolvulus*, Tab. I. fig. 3), si igitur pauca tantum folia floralia et quidem calycina axillares proferunt flores (quod sane fit in normali horum [53]
foliorum successione centripetali) interdum eundem in modum mutatos, nec flos primarius plane tollitur.

Praeter exempla modo nominata ex plantis prius descriptis complura huc pertinent.

COMBINATIONES ANTHOLYSIUM.

63. Postquam brevissime in antholysium formas inquisivimus, iterum dicendum est, omnes, quas distinguimus, formas ejusdem tantum processus significationem esse, metamorphosis nempe retrogradae in flore apparentis; frequenter igitur, interdum etiam necessarie, conjunctas inveniri. Quam conjunctionem vocamus *combinationem*, si unicum efficit adspectum, *complicationem*, si plures antholysis formae in diversis floris organis et sine necessario connexu apparent. Saepe vero combinationem et complicationem accurate distinguere nequimus, ambas igitur conjunctas percensebimus.

1. Combinationes Antholysium cum aliis Floris Abnormitatibus.

64. 1. Combinatio cum metamorphosi abnormi progrediente saepius occurrit; certum aliquod organon medium et quasi centrale constituitur, cui quae antecedunt, metamorphosi progrediente, rotrogradâ autem quae sequuntur similia fiunt; ita interdum corolla se habet, e. g. in *Primulâ elatiore*, *Brassicâ Napo*, *Alceâ roseâ*. Modo contrario alia folia calycina petaloidea fiunt, alia frondescentia,[214] vel petala in sepala, stamina vero mutantur in carpia,[215] etc.

2. Combinationes cum formationibus impeditis frequentes sunt, quod supra exposui- [54]
mus; inprimis regressus, sed apostasis[216] quoque nec non diaphysis[217] et ecblastesis[218] una cum illis inveniuntur.

[212] Tab. III. fig. 4–7.
[213] Röper, de Inflorescentiis in Linnaeâ, I., pag. 433.
[214] Rosa, Tab. III. fig. 3.
[215] Pyrus Malus, cf. supra, 33.
[216] Lilium candidum; vide hoc uti exempla sequentia inter formationes impeditas.
[217] Scabiosa columbaria Hb. soc. Senkenb.
[218] Campanula, Tab. III. fig. 15 et 16, Hyacinthus monstrosus, Hieracium fallax, Coreopsis ferulaefolia, Plantago, Dianthus, etc.

2. Combinationes Antholysium inter se Ipsas.

65. 1. *Regressus* foliorum floralium saepe per complures verticillos invenitur, ita ut regressus foliorum unius verticilli regressum sequentium excitet.[219] In universum regressus in plurimis aliis antholysis formis obviam est, quae conjunctio tam arcta, saepe quoque tam necessaria est, ut vix combinationem appellare possimus.

2. *Virescentia* saepe cum disjunctione[220] invenitur, rarius etiam cum apostasi,[221] frequenter autem cum diaphysi[222] et ecblastesi,[223] ad quas metamorphoses inprimis flores virescentes inclinant.

3. *Disjunctio* saepe virescentiam sequitur, saepe quoque apostasim[224] antecedit; minus arcte consociata cum ecblastesi[225] et diaphysi[226] invenitur disjunctio verticillorum exter- [55]
norum; necessario autem cum disjunctione ecblastesis foliorum pistillarium[227] occurrit, nec non in diaphysi axis elongatus plerumque procrescit per folia pistillaria disjuncta,[228] nisi ovarium prorsus deletum sit.

4. *Apostasis* praeter eas, quas jam dixi combinationes saepe cum diaphysi[229] et ecblastesi[230] reperitur; foliorum externorum apostasis cum illâ, interiorum autem cum hâc.

5. *Diaphysis* cum his antholysibus jam nominata est; cum ecblastesi interdum observatur, quibus conjunctis luxuriosissime flores protruduntur secundarii et umbellulas, capitula, etc. formant.[231]

6. *Ecblastesis* combinationes modo expositae sunt; frequentissimae sunt cum virescentiâ, disjunctione et apostasi.

CAUSAE ANTHOLYSIS.

66. Antholysis, quamvis in singulis floris organis obviam sit, totum tamen laedit florem; de loco igitur loquentes, quo antholysis occurrit, non organa singula floris, sed locum in plantâ, ubi flos sedet antholyticus, intelligimus; et *localem* s. *topicam* s. *solitariam* vocamus antholysim in singulo plurisve plantae floribus obviam; vel omnes plurimive flores morbosi sunt, tum antholysis est *epiphytica*.[232]

Plantae antholyticos proferentes flores, quas ipsas brevi antholyticas appellare possumus, [56]
solitariae occurrunt, antholysis tum *sporadica* dicenda est; vel in certis quibusdam locis, quo antholyses *enchoricae*[233] fiunt, vel tandem in quibusdam annis, annique temporibus sunt frequentiores, tum dici possunt antholyses *enchronicae*.

67. Proclives praesertim sunt ad antholysim plantae structurâ magis evolutâ et typo magis composito praeditae; antholyses igitur frequentiores in Dicotyledoneis.

Maxima autem ad antholysim propensio est floribus, qui primi inflorescentiae terminalis (axis primarii) evolvuntur, quo igitur planta, huc usque sola folia vegetationis ramosque proferens, continuo transit in florum formationem; qui *locus* appellari potest *criticus* s. *regio critica* s. ad significationem magis peculiarem *anthocritica*.[234] In inflorescentiis cymosis, inprimis dichotomis, in hoc

[219] Campanula, Tab. III. fig. 9 et 10; simile exemplar amic. Dr. G. Varrentrapp prope Brückenau invenit.
[220] Rosa, Anagallis, Tab. I. fig. 9 et 10; Torilis Anthriscus, Tab. V. fig. 1 sqq.
[221] Anagallis, Tab. II. fig. 6; Torilis, Tab. V. fig. 11.
[222] Erysimum, Tab. IV. fig. 6 et 7.
[223] Torilis, Tab. V. fig. 12.
[224] Gentiana, Tab. I. fig. 1; Convallaria, etc.
[225] Eadem exempla; Caryophylleae.
[226] Rosa, Anagallis, etc.
[227] Brassica, Tab. IV. fig. 2.
[228] Erysimum, Tab. IV. fig. 6 et 7, etc.
[229] Idem exemplum refero; Dictamnum, etc.
[230] Caryophylleae, Gentiana, etc.
[231] Athamanta, Tab. V. fig. 21, Medicago, etc.
[232] In modum verbi epidemicus formatum vocabulum, *ἐπὶ τοῦ φυτοῦ*.
[233] Melius quam endemicae, quod vocabulum, uti epidemicus cum solis hominibus hominumque morbis convenit. Enchoricus, quod spatio, enechronicus autem, quod tempore circumscriptum est, exprimit.
[234] A. Braun in litt. Iam Göthe hunc transitum, hanc crisim cognovit, uti ex tractatu saepius laudato elucet, nec non in carmine die Metamorphose der Pflanzen inscripto dicit: Um die Achse gedrängt, entscheidet der bergende Kelch sich.

loco critico flos centralis primarius positus est; in racemosis autem infimi flores racemi terminalis; et in his ipsis floribus antholyses solitariae occurrunt, nisi aliis causis efficiuntur. Exempla antholysium in floribus centralibus praebent *Solaneae, Asperifoliae, Gentianeae, Caryophylleae, Hypericum;* in infimis extremisve floribus inflorentiarum racemosarum inveniuntur in *Rumice, Personatis, Leguminosis, Cruciferis, Cleomis, Aconito,* etc.

68. Causae externae praedisponentes, sed aeque ac modo dictae etiam antholyses ipsas efficientes sunt, 1. certi quidam anni annique tempora tempestate humidâ tepidâque, quae praesertim vegetationis organis favet; hic annus 1831 talis est nec non an. 1829 multique alii; ex iisdem causis antholyses vere et autumno saepe frequentes sunt. 2. Locales nonnullae causae in plantas quarundam regionum agunt, ut antholyticae fiant; prope Heidelbergam e. g. *Arenaria trinervia*, prope Monachiam *Hyacinthus botryoides* antholyticus enchorice crescunt; nec non ipse circum Wirceburgam multas antholyses vidi, quas hic, Francofurti, incassum quaero, quamvis plantae, in quibus obviam erant, sint vulgares, e. g. *Erysimum officinale.* [57]

69. Causae internae efficientes partim jam inter praedisponentes tractatae sunt, e. g. praesertim locus criticus. Magni praeterea momenti est hereditas, sed solae antholyses epiphyticae hereditariae esse possunt. Hereditas est, cum plantae lignosae quoque anno similes antholyses proferant; quod saepissime occurrit, immo raro tantum mutantur in statum normalem. Similem tenacitatem in abnormitatibus semel excultis observamus in plantis perennibus; eundemque in modum quaeque propagationis ratio se habet, quâ exemplar solum, non species multiplicatur. Propagatio antholysium per semina in his aeque ac in plantis annuis interdum, multo autem rarius occurrit; sane in talibus tantum, quas semina maturare abnormitas sinit.

Inter internas antholysis causas porro a multis scriptoribus[235] pistilli metamorphosis uti dicunt *virtualis* (*virtuelle Metamorphose*) nuncupatur; de quâ, seminum nempe abortu, dicendum est (praeter id quod ipsa jam abnormitas sit, et aliam, quam non explicaverint, causam habeat), eam esse sequelam nec causam antholysis; pistillum enim serius formatum haud in organa prius evoluta talem in modum agere potest; ex alterâ parte omnes quoque contra loquuntur observationes. [58]

70. Externae antholysis causae efficientes multae sunt, plurimae autem minus perscrutatae. Plerumque nutrimenta copiosa, solum pingue, humiditas et tepor lumine absente, nec non frequens transplantatio indicantur. Alia causa est vulneratio per insecta et mutilatio; praesertim mutilatio inflorescentiae racemosae, cujus flores tum supremi succo adfluente facile antholytici fiunt. Etiam *Uredines*, flori, interdum etiam vegetationis organis enatae, antholysim excitant.

DE IIS, QUAE EX ANTHOLYSIUM PERSCRUTATIONE COLLIGI POSSUNT.

71. Animum in antholyses advertere maximi momenti est ad indagandum vitae vegetabilis processum; omnia autem, quae inde sequuntur, explicare haud meum est, nec hujus libelli ratione nec viribus meis permittitur. Pauca tantum afferam.

In universum antholysis physiologiae plantarum maximi momenti est; nobis demonstrat, vitam vegetabilem ab initio tendere in florem, et ejusmodi constitui evolutionis plantae processum et definiri; cum hic nisus, contendendo cum evolutione singula sola spectante organa, postremo vincat unitatemque et harmoniam minus perfecte in inflorescentiâ optime autem et pulcherrime in flore assequatur et teneat, vel, disjunctivo illo studio singulari florem formatum (antholysi) solvente, ad majorem saepe splendorem largioremque florum formationem progrediatur. [59]

72. Magis in singula inquirentibus antholysis egregie patefacit metamorphosis mysteria, veram enim et ipsam commutationem ostendit, et manifestissime demonstrat, eadem esse nec prorsus

[235] Jäger, Missbild., pag. 111 et aliis locis; Link, Elem. philos. bot., pag. 179; etc.

diversa organa omnia plantarum; docet, quam inane sit multorum botanicorum omnia, quae vel minimum discrimen praebeant, discernendi studium, cum indicet vanas esse tales differentias, et termonomaniam hanc (monomania appellari possit, monomania quae in infinitam multitudinem disceptionemque tendit) accuratiori indagationi nocere, eamque impedire, nec non ipsi botanicae describenti plus damni afferre quam utilitatis. Quo autem minime dicimus, omnes esse delendas differentias, immo, dum cuncta folia ejusdem rationis organa esse cognoscimus, distinguimus gradus ab ipsâ naturâ evolutione saltuatim progrediente effectos et manifestatos.

73. Antholysis igitur praesertim foliaceam omnium organorum vegetabilium naturam palam facit. Involucra, calyces, corollas, quas monophylla, monosepalos, monopetalas dixerant, gamomeria esse docet, i. e. ex multis constituta foliis conjunctis, quae ne ejusdem quidem sint dignitatis (vide 77). Singula harum partium gamomerium folia distinguere et cognoscere docet, quamvis sint occulta; ostendit, ut unum tantum sed mirabile afferam exemplum, partes, quas *Linné* in *Euphorbiis* vocaverat folia corollina, nonnisi glandulas esse marginales foliorum involucralium, quarum binae in rotundas vel lunatas partes commissurales sint connexae, cum foliorum summae partes in minimas contrahantur lacinias, inferiores autem efforment tubum sic [60] dictum calycinum (cf. 83).

74. Stamina esse folia ex antholysis studio luculenter apparet; nec non in lucem ponitur antherarum formatio; foliis enim constituuntur convolutis et efformantibus infundibulum, cujus oris anguli deprimuntur, cum commissura marginum cum costâ folii medianâ conerescat, et efficiunt rimas thecarum; pollen autem in superficie folii internâ secernitur.[236] Quae *R. Brown* de structurâ staminum dixit, haud multum absunt ab hâc sententiâ, quam debemus perscrutationibus novissimis *A. Braun*. Quam autem *Roeper* in *Enumeratione Euphorbiarum* (pag. 46 in notâ) protulit opinionem, stamina esse inflata folia, parenchymate in pollen mutato, antholysis certe non confirmare videtur.

75. Pistillorum rationem antholysis non minus patefacit. Demonstrat unum (*Leguminosae*) vel plura folia (*Papaveraceae*) hic involuta et connata esse, facie superiore introrsum versâ, et clausam cavitatem, saepe in plura loculamenta divisam, efformare; et in suturis commissuras plerumque tumescentes, quas vocant placentas, efficere, ex quibus novae formationes, ovula nempe, procreentur.

Discimus fructuum dehiscentium (e. g. capsularum) folia plerumque non in margine sejungi ad dispergenda semina, sed saepius ad costam medianam, quae in evolutionis processu a marginibus conjunctis dignitate et gravitate superabatur; valvas igitur fructuum non singulis foliis pistillaribus, sed binis dimidiis foliis constitui.

Cognoscimus dissepimenta effici foliorum pistillarium partibus plerumque marginalibus, [61] quae nunc in medio ovario placentas constituunt diversas (e. g. *Solaneae*) vel in unam (placentam centralem) connatas (e. g. *Caryophylleae*); nunc autem ad internam ovarii superficiem placentas formantes in medium extenduntur et ita septa effingunt (*Cruciferae*). Sunt autem plantae (*Labiatae* et *Asperifoliae*), in quibus non solum per dissepimenta separatio, sed perfecta quoque divisio perficiatur medio folio constricto, quae formatio antholysi solvitur, et in vera oculisque manifesta disponitur folia pistillaria.

Simili ratione antholysis certiores nos facit de naturâ seminum sic dictorum nudorum, quae dimidio (*Labiatae, Asperifoliae*) vel uno (multae *Rosaceae, Ranunculaceae*), saepe quoque duobus (*Gramineae, Compositae*) includuntur foliis pistillaribus.

76. Denique in obscuram ovulorum naturam nos inspicere sinit antholysis. Ovula apparent gemmae altioris gradus, quae ut evolvantur, solâ fecundatione polline effectâ fieri potest. Ovulorum tegumenta folia sunt, funiculus autem umbilicalis axis, qui evolutione inversâ, extrorsum nempe directâ (in floribus virescentibus), reverâ in modum caulis foliorumque viridium commutantur (cf. 44).

77. Antholysis porro successionem foliorum cognoscere nos docet. Veros verticillos i. e. tales,

[236] A. Braun in litt. Cf. Tab. V. fig. 10. Speramus fore ut plura de spectatissimâ hâc detectione ejus auctor mox in publicum prodat.

quorum partes s. folia ejusdem dignitatis, simul orta, eundemque in modum evoluta sint, nusquam inveniri ostendit; etiam in illis, in quibus ne aestivatio quidem certiores nos facere possit (aestivatio inprimis valvata, contorta, aliae), in quibus vel connatae sint partes, folia non simul, sed in certâ quâdam formata esse successione; quin aestivationem interdum in falsam nos ducere [62] viam confirmat; e. g. lateralia *Cruciferarum* sepala, quae cum facilius regressu, apostasi et ecblastesi mutentur, inferiora sunt et priora, in aestivatione interiora videntur. Complura alia hujusmodi exempla inveniuntur.

Praeterea ex antholysi discimus successionem verticillorum; diversorum enim graduum folia plerumque non eâdem ratione neque in eodem ordine collocantur; sed in successione et ordine non minus ac in formâ et evolutione foliorum per distinctiores procedit natura gradus.[237]

78. Pauca quaedam de antholysis dignitate dixi; sed et ad universam biologiam atque physiologiam maximi esse potest momenti, et multorum peculiarium organorum naturam explicandi nobis praebet facultatem. Quae autem indagationes, cum illae in philosophiam, hae vero in organographiam magis quam in doctrinam de abnormitatibus has ipsas contemplantem pertineant, hic nimis longe nos abducerent.

APPENDIX. [63]

LYSIS INFLORESCENTIARUM, ANTHESMOLYSIS.

79. Inflorescentiae (anthesmi, *ἀνθεσμοὶ*) integrum quoddam et unum esse apparent, et saepe simillimae sunt ipsis floribus; ita ut *Compositarum* capitula nominata sunt flores compositi, nec non adhuc *Euphorbiarum* inflorescentias nonnulli putant esse flores simplices. Vel magis in abnormitatibus inflorescentiarum similitudo elucet; et anthesmolysim cum antholysi mutatis mutandis prorsus fere congruentem distinguimus.

I. METAMORPHOSIS RETROGRADA FOLIORUM SUBFLORALIUM VEL SINGULORUM FLORUM, CUI CERTUS QUIDAM AD INFLORESCENTIAM EST RESPECTUS.

1. Mutatio Florum Centralium in Formas Floribus Periphericis Similes.

80. Haec metamorphosis plerumque amplificationem, saepe quoque irregularitatem corollae efficit, quarum sequelam, internorum verticillorum commutationem, jam supra (19) descripsimus. Exemplo sunt *Viburnum Opulus, Hydrangea hortensis, Scabiosa arvensis;* inprimis autem multae *Compositae radiatae,* inter quas singularem adspectum praebet *Calendula officinalis,* cujus flosculi discoidei periphericis eo quoque similes fiunt, quod semina maturant.

2. Mutatio Florum Periphericorum in Inflorescentias. [64]

81. Qui transitus pluribus antholysis modis efficitur, quâ de re cf. 62. Antholysis florum periphericorum efficit anthesmolysim, cum certâ quâdam ratione mutet totius inflorescentiae habitum. Non cognosci nequit talis mutatio, ubi vestigia antholysis remanebant, quibus autem absentibus ab abnormitate (87) descriptâ distingui non potest. Exempla inter *Umbelliferas, Compositas,*[238] alias invenimus.

3. Frondescentia Foliorum Subfloralium; Evolutio eorum ubi in Statu Normali desunt.

82. Haec abnormitas cum virescentiâ uti modo dictae anthesmolysis formae cum regressu comparari possunt; et folia subfloralia, quae calyces fingunt exteriores vel involucra, plane eodem modo mutantur, quo calyces ipsi.

[237] Cf. tractatum saepius laudatum auctore Alex. Braun in Nov. Act. Leop., Vol. XV. 1. Ordnung der Schuppen an Tannzapfen, in compluribus locis.

[238] Tab. V. fig. 22.

Quae virescentia frequenter occurrit, cum folia subfloralia vegetationis foliis maxime sint affinia. *Aroideae* exempla proferunt, nec non *Gramineae* et *Junceae*, quae hâc metamorphosi formam acquirunt interdum viviparam dictam. In *Euphorbiis* semper disjunctio una apparet. *Plantago* saepe invenitur cum bractearum frondescentiâ (varietas phyllostachya); folia involucralia frondescentia conspiciuntur in *Convolvulo*,[239] in *Scabiosâ*, in quâ etiam virescentia palearum et calycum exteriorum obviam est. *Compositarum* folia involucralia saepe frondescunt, interdum paleae quoque, quae etiam apparent in receptaculis normaliter nudis, e. g. in *Hieracio*, *Pyrethro*, *Coreopside*. Eadem in *Umbelliferis* reperiuntur. In *Tiliâ* vidi intra paniculam bracteas iis, quibus tota suffulta est inflorescentia, similes. In *Cruciferis*, e. g. *Brassicâ* et *Cheiranthо*, saepe in corymbo apparent folia subfloralia.

4. Disjunctio Foliorum Subfloralium. [65]

83. Quae disjunctio rara est, cum involucra gamomeria ipsa minime sint frequentia. Sola *Euphorbiarum* exempla mihi innotuerunt. Involueri (calycis *L.*) laciniae amplificantur, glandulae (petala *L.*) disjunguntur, postremo folia libera, margine glandulis s. callosis intumescentiis instructa inveniuntur. *Röper* hunc processum in *Enumeratione Euphorbiarum* optime exposuit, pluresque addidit icones.

II. METAMORPHOSIS RETROGRADA INFLORESCENTIARUM, AXE NECESSARIE MUTATO.

1. Apostasis Foliorum Subfloralium eorumve Productorum.

84. Apostasim glumarum insignem observavi in *Lolio perenni*. In *Euphorbiâ* apostasis foliorum involucralium disjunctorum interdum occurrit; *Convolvulum Sepium*, vide Tab. I. fig. 3. Inter *Compositas* saepius obviam est; vidi in *Leontodonte*, *Waldiâ perfoliatâ*, aliis. Capitulum primarium *Eryngii* interdum praebet folia involucralia cum floribus nonnullis apostatica; eximias vidi umbellulas apostaticas in *Athamantâ Cervariâ*.

2. Diaphysis Inflorescentiarum.

85. Eodem modo, quo axis in flore terminatus est, caulis plerumque in inflorescentiis, in illis quoque, quae flore centrali non terminantur (in inflorescentiis racemosis), finitur. Interdum autem in modum abnormem elongatur, et metâ superatâ iterum folia vegetationis profert et folia subfloralia nec non flores ipsos.

In *Tritico repente* culmi ex spiculis florentibus proveniebant; ex *Pini Laricis* strobilis interdum rami foliosi.[240] Ex inflorescentiae centro in *Euphorbiâ palustri Röper*[241] novum [66] involucrum solos flores masculos includens emergere vidit; et ex *Primulae* umbellâ interdum altera procrescit. Diaphyses ipsas capitulorum in *Compositis* non animadverti, vestigium autem hujus anthesmolysis me in *Spilanthe oleraceâ*[242] vidisse puto. *Umbelliferae* saepe umbellas diaphytas ostendunt, rarius diaphytas umbellulas. Nec non ramulum foliosum in *Coronillâ variâ* e centro umbellae provenientem observavi.

3. Ecblastesis Foliorum Subfloralium normaliter Sterilium.

86. *Euphorbia* interdum ex axillis foliorum involucralium apostaticorum ramos profert. Flores axillares ex foliis involucralibus *Convolvuli Sepium*,[243] nec non ex squamis calycinis *Dianthi caryophylli* provenientes saepius inveni. In foliorum subfloralium verticillo nonnunquam in *Malvacearum* praesertim cultis speciebus flores axillares observantur.[244] Haud rari sunt in foliis involucralibus *Anemonarum*.

[239] Tab. I. fig. 3.
[240] De Candolle Organogr., Tab. XXXVI. fig. 3.
[241] Enum. Euphorb., pag. 36.
[242] Tab. V. fig. 29.
[243] Tab. I. fig. 3.
[244] Spenner, Fl. Friburg., pag. 883.

4. Procreatio Productorum Axillarium Majorum loco Minorum ex Foliorum Subfloralium Axillis.

87. Haud ubique hanc abnormitatem merâ ecblastesi explicare possumus; gemmae axillares, sane minores quidem, jam in statu normali aderant, quae saepe (vide supra) [67] antholysi in ramos foliosos integrasve inflorescentias mutantur; plerumque autem nova haec proles jam ab initio ad majorem evolutionem destinata, nec serius metamorphosi retrogradâ amplificata esse videtur.

In *Graminеis* saepe ex axillis bractearum novae spiculae proveniunt loco singulorum florum; id quod magni momenti est in *Lolio*, cum hâc metamorphosi *Tritico*, *Festucae* aliisque *Gramineарum* generibus simillimum fiat. Interdum gramina ex bractearum axillis gemmas foliiferas proferunt, quo vivipara fiunt. Alia exempla praebent *Hyacinthus* et *Strelitzia*. In *Plantagine lanceolatâ* sessilia, rarius quoque pedunculata capitula ad basin, nonnunquam in apice capituli primarii procrescunt. *Dipsacus* et complures *Scabiosae* similes abnormitates (quo proliferae vel viviparae dicuntur) ostendunt. Eodem modo multae *Compositae* se habent; *Senecio*, *Bellis*, *Anthemis*, *Coreopsis*, *Calendula*, *Hieracium*, *Lactuca* aliae proliferae inveniuntur. Affinis est etiam *Umbelliferarum* proliferatio, e. g. in *Eryngio*, *Bupleuro*, *Apio*, *Aethusâ*, *Sio*, *Athamantâ*, *Peucedano*, *Heracleo*, *Pastinacâ*, *Laserpitio*, etc. Postremo *Sanguisorbam* non possum non nominare.

88. Anthesmolyses eâdem ratione inque iisdem locis proveniunt ac antholyses, nec non iisdem efficiuntur causis. De iis, quae ad melius intelligendam historiam plantarum derivari possint ex anthesmolysibus, multa dicenda sint. Pauca aliis locis sunt memorata; plura praetermitto, cum florum metamorphosim retrogradam exhibens similitudinem tantum in mutandis inflorescentiis indicaturus essem. Quae quoad vires effecisse mihi videor, itaque dissertationem [68] hanc, primitias meas et tironis quasi rudimentum, benevolo trado lectori scientiam colenti.

EXPLICATIO TABULARUM.

TABULA I.

Fig. 1. Gentiana campestris cum apostasi et ecblastesi sepali externi, ceteris tribus sepalis amplificatis.

Fig. 2. Anemone ranunculoides, in cujus involucro 4phyllo flos 5folius primo folio frondescente sedet, ex cujus centro completus flos secundarius procrescit.

Fig. 3. Convolvulus Sepium cum frondescentiâ et ecblastesi amborum f. subfloralium, altero apostatico, et cum frondescentibus duobus exterioribus calycis 6meris foliis.

Fig. 4–5. Amygdalus Persica aucto carpiorum numero, tribus disjunctis et margine altero frondescentibus. Fig. 5. Sectio transversalis.

Fig. 6–7. Alcea rosea. Fig. 6. Sectio verticalis floris pleni, in cujus columnâ androeceâ alabastra completa, quorum alterum dissectum est, apparent. Fig. 7. Pars columnae alius floris, in quâ carpiorum verticillus staminibus et petalis cinctus ortus est.

Fig. 8–10. Anagallis arvensis phoenicea cum floribus virescentibus. Fig. 8. Virescentia incipiens; f. corollinis gamomeribus, margine purpurascentibus, uno ex floribus 6meri. Fig. 9. Flos virescens, petalis plane disjunctis post ipsam anthesin vegetis atque amplificatis. Fig. 10. Flos similis in anthesi; adhuc stamina conspiciuntur.

TABULA II.

Fig. 1–7. Anagallis arvensis phoenicea. Fig. 1. Flos virescens diu post anthesin, capsulâ amplificatâ; ea, quae continebat, fig. 2 depicta sunt ovula mutata, quorum nonnulla fig. 3–5 octies aucta apparent.

Fig. 6. Flos virescens calyce apostatico.

Fig. 7. Flos virescens diaphytus, calyce apostatico, petalis minimis colore rosaceo, vel frondescentibus.

Fig. 8–18. Gilia glomeriflora. Fig. 8. Flos virescens corollâ minimâ, ovario multum amplificato.

Fig. 9. Similis flos, ovario autem majore, stipitato.
Fig. 10. Flos virescens omnibus partibus inprimis ovario longe stipitato amplificatis, staminibus inclusis.
Fig. 11. Flos similis staminibus exsertis, f. pistillaribus apice disjunctis.
Fig. 12. Flos similis, minor, f. calycinis et pistillaribus magis disjunctis.
Fig. 13. Flos virescens f. corollinis et pistillaribus frondescentibus.
Fig. 14. Flos virescens f. calycinis plane disjunctis, f. corollinis minimis, incisis, pistillo abolito.
Fig. 15. Ovarium simile illi fig. 8 depicto, sectione transversâ apertum.
Fig. 16. Ovarium simile, sectione longitudinali apertum.
Fig. 17. Ovarium illi fig. 9 depicto simile, sectione transversâ apertum, placentis peripheriis fila (loco funiculorum umbilicalium) proferentibus.
Fig. 18. Ovarium floris fig. 10 depicti dissectum et expansum; tribus placentis sterilibus praeter singulum locum, ex quo multa ovula plus minusve virescentia procrescunt.
Fig. 4–14 bis, fig. 3–5 et 15–18 octies magnitudinem naturalem superant.

TABULA III.

Fig. 1–8. Rosae. Fig. 1. Flos dissectus tubo calycino abolito, receptaculo hemisphaerico.
Fig. 2. Flos dissectus, ex cujus receptaculo stipes petala stamina et virescentia f. pistillaria proferens attollitur.
Fig. 3. Flos regressu, disjunctione, apostasi, diaphysi multipliciter mutatus; f. calycinis (quorum unius decidui cicatrix conspicitur) aliis frondescentibus, aliis petaloideis. Folia viridia incisa, quae conspiciuntur in apice axis, calycis loco florem secundarium includunt.
Fig. 4–6. Flores dissecti, qui ad internum receptaculi marginem alabastra secundaria (dissecta) proferunt.
Fig. 7. Similis flos dissectus; ex superficie internâ receptaculi provenit flos secundarius pedunculo elatus folioso foliisque incisis cincto, diaphysis vestigia ostendens, cum alabastro altero connatus. Fig. 8 hujus floris secundarii cum alabastro connati faciem externam ex latere opposito exhibet.
Fig. 9–16. Campanulae. Fig. 9. Externae, fig. 10 internae partes floris Campanulae persicifoliae regressu et disjunctione multifariam mutatae.
Fig. 11. Stylus floris alius ex eodem exemplari antherae thecam proferens; bis auctus.
Fig. 12. Campanula rapunculoides, staminibus in alteram corollam mutatis, quae corpusculum flavum antherae similem tanquam originis vestigium ostendit. Corollae dissectae sunt et expansae.
Fig. 13. Ejusdem plantae flos virescens, f. pistillaribus amplificatis apice disjunctis.
Fig. 14. Styli ex ejusdem plantae flore, conjuncti, quinquefidi, parte unâ proferente flavum corpusculum glabrum antherae thecam inapertam referens.
Fig. 15. Formatio sepalorum impedita de eâdem plantâ, in quorum centro complura f. pistillaria disjuncta evoluta sunt, cum ovulis ad margines. Unum f. sepaloideorum ex axillâ profert ramulum.
Fig. 16. Campanulae rapunculoidis ramulus foliosus loco floris, qui calycis formatio impedita esse videtur cum ecblastesi.

TABULA IV.

Fig. 1–2. Brassica oleracea. Fig. 1. Flos defloratus, cujus sepala exteriora persistentia ecblastesi laborant.
Fig. 2. Flos apostasi et ecblastesi f. calycinorum, disjunctione et ecblastesi f. pistillarium, nec non generatione novi minus abnormis pistilli intra primarium maxime mutatus.
Fig. 3–20. Erysimum officinale. Fig. 3. Flos virescens staminibus minus mutatis, pistillo in saccum amplum converso ovula monstrosa proferente.
Fig. 4. Flos similis f. pistillaribus apice disjunctis.
Fig. 5. Flos similis f. pistillaribus plane disjunctis, novis intra ea foliis procrescentibus.
Fig. 6. Flos virescens f. corollinis abolitis, f. pistillaribus axe elongato totamque inflorescentiam proferente apostaticis.
Fig. 7. Flos similis, f. tamen corollinis pistillaribusque in magna f. viridia commutatis.
Fig. 8–11. Stamina in f. viridia transeuntia. Fig. 8–10 f. tetraptera exhibent; fig. 9, sectionem prioris transversalem; fig. 11, postremo transitum alio eoque rariore modo effectum.
Fig. 12. Ovarium sacciforme non disjunctum, dissectum; ovulis amplificatis, setosis, foramine (micropyle) per embryonem protrusum dilatato.
Fig. 13. Simile ovarium, in quo ovulorum loco folia hirta in placentâ collocantur vel petioli s. stipites parvi. Fig. 14–15 talia folia ostendunt.
Fig. 16–17. Folia pistillaria disjuncta ex floribus ceterum normalibus in margine dentes ovuligenos ipsaque ovula ferentes. Fig. 18–20 singula ovula exhibent: 18 est a; 19, b; et 20, c.
Fig. 3–7 et 13, 16 et 17 quater, fig. 8-11, 14 et 15 octies, fig. 12 et 18–20 sedecies magnitudinem naturalem superant.

TABULA V.

Fig. 1–13. Torilis Anthriscus. Fig. 1. Flos virescens mesogynus; f. pistillaribus apice disjunctis; unum f. corollinorum amotum est, ut ovarium melius conspiciatur.

Fig. 2. Flos viridis, uti omnes, qui sequuntur, hypogynus.

Fig. 3. Flos viridis f. pistillaribus prae ceteris amplificatis.

Fig. 4. Flos viridis, inter cujus f. pistillaria quatuor folia viridia incisa (tegumenta ovulorum) apparent.

Fig. 5. Folia pistillaria cum duobus ovulorum foliis, quae stipitem parvum (axis rudimentum) ferunt.

Fig. 6. Flos viridis f. pollinaribus petiolatis, amplificatis, rotundatis, incisis, tetrapteris s. planis. Folia plana secundum ea, quae in 74 exposita sunt, exteriore infundibuli pollinaris parte formantur.

Fig. 7. Sectio transversa f. pollinaris tetrapteri.

Fig. 8. Flos viridis f. calycinis evolutis, f. pollinaribus sessilibus, ovalibus, incisis.

Fig. 9 et 10. Folia pollinaria tetraptera.

Fig. 11. Flos viridis, calyce amplificato apostatico.

Fig. 12. Flos viridis, sepalis ex axillis flores et umbellam proferentibus; f. pollinaria desunt. a. Flos secundarius, incompletus sepalis apostaticis. b. Flos incompletus virescens. c. Umbella, quae ipsa ex flore secundario ecblastesi orta videtur; floris tertiarii petalum d. adhuc superest.

Fig. 13. Flos viridis hypogynus, ex quo novus flos diaphysi provenit, qui iterum ecblastesi aut diaphysi umbellulam tertiariam cum fructibus maturescentibus profert.

Fig. 14–21. Athamanta Cervaria. Fig. 14. Ecblastesis ex f. calycini amplificati axillâ.

Fig. 15. Ecblastesis ex f. calycini amplificati hypogyni axillâ.

Fig. 16. Similis antholysis.

Fig. 17. Ecblastesis f. calycinorum vix mutatorum vel disjunctorum; carpia disjuncta.

Fig. 18. Diaphysis uno flore secundario.

Fig. 19. Diaphysis duobus floribus secundariis, calyce paulum dirupto.

Fig. 20. Flos diaphytus dissectus.

Fig. 21. Umbellula secundaria ecblastesi et diaphysi orta ex flore primario, cujus magnam partem adhuc videre licet.

Fig. 22–29. Compositae. Fig. 22–26. Senecio vulgaris. Fig. 22. Capitulum flosculis centralibus virescentibus, periphericis in inflorescentias secundarias mutatis. Fig. 23. Flosculus normalis. Fig. 24. Flosculus paulo virescens, uti plurimi in illo capitulo. Fig. 25. Flosculus virescens, pappo partim in folia, ovario in stipitem converso, corollâ diminutâ. Fig. 26. Flosculus plane viridis inflorescentiae vestigia in corollâ inflatâ includens. Singuli hi flosculi ex illo capitulo (fig. 22) desumti, praeter normalem (fig. 23).

Fig. 27. Hieracii fallacis fructus, qui diaphysi ramulum dense foliosum profert.

Fig. 28. Flosculus virescens Calendulae officinalis calyce et corollâ commutatis in quina folia novum receptaculum, diaphysi ortum, includentia.

Fig. 29. Capitulum Spilanthis oleraceae dissectum, medio constrictum et ita diaphysim orientem indicans.

Omnes figurae, exceptis fig. 22 bis auctâ et fig. 29 magnitudinem naturalem exhibente, quater auctae sunt.*

* It has been found necessary to omit the figures, partly colored, which illustrated this dissertation, on account of the difficulty of reproducing them; but the references and explanations are retained in full. The subject is treated in so completely analytical a manner that no effort has been made to include the species referred to in the index at the end of the volume. — Eds.

II.

SKETCH

OF THE

BOTANY OF DR. A. WISLIZENUS'S EXPEDITION

FROM

MISSOURI TO SANTA FÉ, CHIHUAHUA, PARRAS, SALTILLO, MONTEREY, AND MATAMOROS.

PRINTED SEPARATELY FROM A "MEMOIR OF A TOUR TO NORTHERN MEXICO IN 1846 AND 1847, BY A. WISLIZENUS, M.D., PRINTED FOR THE USE OF THE SENATE OF THE UNITED STATES." WASHINGTON, 1848.

DR. WISLIZENUS has intrusted to me his very interesting botanical collections, with the desire that I should describe the numerous novelties included in them. Gladly would I have done so, had not leisure been wanting, and were I not here (in St. Louis) cut off from large collections and libraries. As it is, I can only give a general view of the flora of the regions traversed, and describe a few of the most interesting new plants collected; with the apprehension, however, that some of them may have been published already from other sources, without my being aware of it.

In examining the collections of Dr. Wislizenus, I have been materially aided by having it in my power to compare the plants which Dr. Josiah Gregg, the author of that interesting work "The Commerce of the Prairies," has gathered between Chihuahua and the mouth of the Rio Grande, but particularly about Monterey and Saltillo, and a share of which, with great liberality, he has communicated to me. His and Dr. W.'s collections together, form a very fine herbarium for those regions.

The tour of Dr. Wislizenus encompassed, as it were, the valley of the Rio Grande and the whole of Texas, as a glance at the map will show. His plants partake, therefore, of the character of the floras of the widely different countries which are separated by this valley. Indeed, the flora of the valley of the Rio Grande connects the United States, the Californian, the Mexican, and the Texan floras, including species or genera, or families, peculiar to each of these countries.

The northeastern portion of the route traverses the large western prairies, rising gradually from about 1,000 feet above the Gulf of Mexico, near Independence, Missouri, to 4,000 feet west of the Cimarron River. The plants collected on the first part of this section, as far west as the crossings of the Arkansas River, are those well known as the inhabitants of our western plains. I mention among others, as peculiarly interesting to the botanist, or distinguished by giving a character to the landscape, in the order in which they were collected, *Tradescantia Virginica*, *Phlox*

aristata, Œnothera Missouriensis, serrulata, speciosa, &c., *Pentstemon Cobaea, Astragalus caryocarpus* (common as far west as Santa Fé), *Delphinium azureum, Baptisia australis, Malva Papaver, Schrankia uncinata* and *angustata, Echinacea angustifolia, Aplopappus spinulosus, Gaura coccinea, Sida coccinea, Sophora sericea, Sesleria dactyloides, Hordeum pusillum, Engelmannia pinnatifida, Pyrrhopappus grandiflorus, Gaillardia pulchella,** *Argemone Mexicana* (with very hispid stem and large white flowers).

The plants collected between the Arkansas and Cimarron rivers are rarer, some of them known to us only through Dr. James, who accompanied Long's expedition to those regions in 1820. We find here *Cosmidium gracile,* Torr. and Gr., which has also been collected about Santa Fé and farther down the Rio Grande; *Cucumis? perennis,* James, found also near [88 (4)] Santa Fé and about Chihuahua, and by Mr. Lindheimer, in Texas; the petals being united about two-thirds of their length, it cannot be retained under the genus *Cucumis; Hoffmannseggia Jamesii,* T. and G., was also gathered on this part of the journey; several species of *Psoralea, Petalostemon* and *Astragalus;* also Torrey's *Gaura villosa* and *Krameria lanceolata; Erysimum asperum,* which before was not known to grow so far south; *Polygala alba, Lygodesmia juncea.* Here we also, for the first time, meet with *Rhus trilobata,* Nutt., which, farther west, becomes a very common plant.† A new *Talinum,* which I have named *T. calycinum,*[1] was found in sandy soil on the Cimarron. This plant has, like the nearly allied *T. teretifolium* of the United States, a remarkable tenacity of life, so much so that specimens collected, pressed and "dried," in June, 1846, when they reached me in August, 1847, fourteen months later, grew vigorously after being planted.

Psoralea hypogæa, Nutt., was collected near Cold Spring, and *Yucca angustifolia,* from here to Santa Fé.

From Cedar Creek the mountainous region commences with an elevation of near 5,000 feet above the Gulf, and extends to Santa Fé to about 7,000 feet. With the mountains we get also to the region of the pines, and of the cacti. Dr. Wislizenus has here collected two species of *Pinus,* both of which appear to be undescribed, so that I venture to give now a short account of them. The most interesting one, on account of its useful fruit, as well as its botanical associations, is the nut pine of New Mexico (Piñon), *Pinus edulis,*[2] nearly related to the nut pine of

[1] TALINUM CALYCINUM, n. sp.: rhizomate crasso, caulibus demum ramosis; foliis subteretibus elongatis, basi triangulari productis; pedunculis elongatis nudis; cyma bracteosa; sepalis 2 ovato-orbiculatis, basi productis, cuspidatis, persistentibus; petalis fugacibus calycem bis superantibus; staminibus sub 30; stylo elongato, stigmatibus 3 abbreviatis.

In sandy soil on the Cimarron, fl. in June. Differs from *T. teretifolium* by its larger leaves, larger flowers, much larger persistent sepals, larger fruit and seed. Leaves 1½ to 2 inches long, flowers 10 to 11 [15] lines in diameter; capsule and seeds twice as large as in *T. teretifolium.*

[2] PINUS EDULIS, n. sp.: squamis turionum ovatis acutis adpressis; laciniis vaginarum abbreviatarum circinato-revolutis, demum deciduis; foliis binis brevibus rigidis, curvis, tenuissime striatis, margine lævibus, supra concavis glaucis, subtus convexis viridibus; strobilis sessilibus erectis, subgloboso conicis, squamis apice dilatato pyramidatis, inermibus; seminibus obovatis, apteris, magnis, testa tenuiore.

Not rare from the Cimarron to Santa Fé, and probably throughout New Mexico. A small tree, 10 to 20, rarely 30 feet high; trunk 8 to 12 inches in diameter; leaves 12 to 18 lines long, and, as is the case in all other pines, concave on the inner or upper surface when in twos, and carinate when in threes, which in our species is very seldom the case. Cones about 18 lines in diameter; seeds about 6 lines long, and 4 in diameter; shell much thinner than a hazel-nut's; kernel, when slightly baked, very pleasant.

* Abundant in the sands about the Arkansas River, with beautiful flowers, but only about 6 inches high; certainly annual.

† Like many other plants mentioned here, it has been collected in abundant and beautiful specimens by *Mr. A. Fendler,* a young German collector, who has investigated the regions about Santa Fé during last season (1847), and has made most valuable and well-preserved collections, some sets of which he offers for sale. I shall repeatedly be obliged to refer to him when speaking of the flora of Santa Fé.

northeastern Mexico, *Pinus osteosperma*[3] (specimens of which were sent to me by Dr. Gregg, [89 (5)] as collected on the battlefield of Buena Vista), and to the nut pine of California, *P. monophylla*, Torr. and Frem., — these three species being the western representatives of *Pinus Pinea* and *Cembra* of the eastern continent.

The second species, *Pinus brachyptera*,[4] is the most common pine of New Mexico, and the most useful for timber. A third species, *Pinus flexilis*, James, was overlooked by Dr. Wislizenus, but has been collected in fine specimens, by Mr. Fendler, about Santa Fé. Its leaves in fives and pendulous cylindrical squarrose cones assimilate it to *Pinus Strobus;* but the seed is large and edible, as Dr. James has already remarked, and the leaves are not serrulate and much stouter. The Piñones, so much eaten in Santa Fé, appear principally to be the product of *Pinus edulis.* I shall have occasion to speak of three other *pines* when I come to the flora of the mountains of Chihuahua.

Linum perenne makes its first appearance here, and continues to Santa Fé, as well as the justly so-called *Lathyrus ornatus.* Several species of *Potentilla, Œnothera, Artemisia,* and *Pentstemon,* were collected in this district.

Among the most remarkable plants met with were the *Cactaceæ.* After having observed on the Arkansas, and northeast of it, nothing but an *Opuntia*, which probably is not different from *O. vulgaris,* Dr. W. came at once, as soon as the mountain region and the pine woods commenced, on several beautiful and interesting members of this curious family, an evidence that he approached the favorite home of the cactus tribe, Mexico.

On Waggon-mound the first (flowerless) specimens of a strange *Opuntia* were found, with an erect, ligneous stem, and cylindrical, horridly spinous, horizontal branches. The [90 (6)] plant was here only 5 feet high, but grows about Santa Fé to the height of 8 or 10 feet, and continues to be found as far as Chihuahua and Parras. In the latter more favorable climate it grows to be a tree of 20 or 30, and perhaps even 40 feet high, as Dr. W. informs me, and offers a most beautiful aspect when covered with its large red flowers. It is evidently the plant which Torrey and James doubtfully, though incorrectly, refer to *Cactus Bleo,* HBK. It is nearly allied to *Opuntia furiosa,* Willd., but well distinguished from it; and as it appears to be undescribed, I can give it no more appropriate name than *O. arborescens,*[5] the Tree Cactus, or Foconoztle, as called

[3] PINUS OSTEOSPERMA, n. sp.: squamis turionum elongato-acuminatis, fimbriatis, squarrosis; laciniis vaginarum abbreviatarum circinato-revolutis, demum deciduis; foliis ternis binisve brevibus, tenuioribus, rectiusculis, margine lævibus, utrumque tenuissime striatis, supra glaucis, subtus virescentibus; strobilis sessilibus, erectis, subglobosis, inermibus; seminibus obovatis, apteris, magnis, testa dura.

Mountain borders, near Buena Vista, and about Saltillo. A small tree, 10 to 20 feet high; leaves in threes, more rarely in twos, 1 to 2 inches long, much more slender than in the foregoing species; nut of the same size, but much harder. *Pinus monophylla* has broadly ovate, obtuse, adpressed scales of the young shoots and mostly single, terete leaves; cone and seeds are similar to both others.

[4] PINUS BRACHYPTERA, n. sp.: squamis turionum longe acuminatis, fimbriatis, squarrosis, subpersistentibus; vaginis elongatis adpressis; foliis ternis (raro binis s. quaternis) utrumque viridibus et aspero striatis; strobilis erectis, ovatis s. elongato conicis, squamis recurvo aculeatis; seminibus obovatis breviter alatis.

Mountains of New Mexico, common. A large and fine tree, often 80 to 100 feet high, 2 and even 3 feet in diameter; sheaths 6 lines long, mostly black; leaves generally in threes, rough, 3½ to 6 inches long, in the specimens before me, crowded towards the end of the branches; cones 2½ to 3½ inches long; seed larger than the wing, without this 3 to 4 lines long and 2 wide.

[5] OPUNTIA ARBORESCENS, n. sp.: caule ligneo erecto, ramis horizontalibus, ramulis cylindricis, tuberculatis, aculeatissimis; areolis oblongis, brevissime tomentosis, aculeos 12–30 corneos stramineo-vaginatos teretes undique porrectos gerentibus; ramulis versus apicem floriferis; ovario tuberculato, tuberculis sub-20 apice sepala subulata et areolas tomentosas cum setis paucis albidis gerentibus; sepalis interioribus 10–13 obovatis; petalis obovatis, obtusis s. emarginatis; stigmatibus sub-8 patulis; bacca flava, sicca, ovato-globosa, tuberculata, profunde umbilicata.

Mountains of New Mexico to Chihuahua, Parras, and Saltillo; flowers in May and June; fruit, at least about Santa Fé, ripening the second year (Fendler); in the north 5 to 10, south 20 and more feet high, 5 to 10 inches in diameter, last branches 2 to 4 inches long; spines of the specimens on Waggon-mound 20 to 30 in each bunch; further

by the Mexicans, according to Dr. Gregg. The stems of the dead plant present a most singular appearance; the soft parts having rotted away, a net-work of woody fibres remains, forming a hollow tube, with very regular rhombic meshes, which correspond with the tubercles of the living plant.

The first *Mamillaria* was also met with on Waggon-mound, — a species nearly related to *M. vivipara* of the Missouri, and also to the Texan *M. radiosa* (Engelm. in Plant. Lindh. inedit.), but probably distinct from either. Mr. Fendler has collected the same species near Santa Fé.

On Wolf Creek the curious and beautiful *Fallugia paradoxa*, Endl., looking like a shrubby *Geum*, was found in flower and fruit; also a (new?) species of *Streptanthus*, and an interesting *Geranium*, which I named *G. pentagynum*,[6] because of its having its five styles only slightly united at base, while most other *Gerania* have them united for about two-thirds or more [91 (7)] of their length.

In the prairies about Wolf Creek, in an elevation of between 6,000 and 7,000 feet, the smallest of a tribe of *Cactaceæ* was discovered, numerous species of which were found in the course of the journey south and southeast: several others have also been discovered in Texas. I mean those dwarfish *Cerei*, some of which have been described with the South American genus *Echinopsis*, or have been referred alternately to *Cereus* or *Echinocactus*, and which I propose to distinguish from all these under the name of *Echinocereus*,[7] indicating their intermediate position between *Cereus* and *Echinocactus:* they approach more closely to *Cereus*, in which genus they, as well as the genus *Echinopsis*, should perhaps be included as sub-genera.

The species mentioned above is distinguished from all others known to me by its yellowish green flowers, the others having crimson or purple flowers. I have named it, therefore, *Echinocereus viridiflorus*.[8]

south only 12 to 20, generally fewer on the under side of the branchlets; spines horn-colored, with straw-colored loose sheaths, from 3 to 10 lines, generally about 6 lines long. Flowers purple, 3 inches in diameter; stamens red; fruit about 1 inch long, yellow.

[6] GERANIUM PENTAGYNUM, n. sp.: perenne, caule erecto ramoso cum petiolis retrorso-piloso; foliis strigoso-pubescentibus inferioribus 7-, superioribus 3–5-partitis, segmentis inciso-lobatis; pedicellis binis, glanduloso-pubescentibus; sepalis glandulosis, aristatis; petalis basi villo brevi instructis, ad venas pilosiusculis, obovatis integris; filamentis ciliatis; ovario glanduloso; stylis ima parte solum connatis; capsula glanduloso-pubescente.

On Wolf Creek, flowers in June. Several stems 1 foot high from a large ligneous rhizoma; similar to *G. maculatum*, but easily distinguished from this and most other species by the styles being united only for ¼ or ⅕ of their length; flowers of the same size, but aristæ of sepals much larger; leaves only 2 or 2½ inches wide.*

[7] ECHINOCEREUS, n. gen. Perigonii tubus ultra germen productus, abbreviatus. Sepala exteriora s. tubi subulata, in axillis tomentosis setas s. aculeos gerentes. Sepala interiora subpetaloidea et petala longiora pluriserialia corollam breviter infundibuliformem s. sub-campanulatam æmulantia. Stamina numerosissima tubo adnata, limbo breviora s. eum subæquantia. Stylus stamina vix superans. Stigma multiradiatum. Bacca pulvilligera setosa s. aculeata, perigonio coronata. Seminum testa dura tuberculata nigra. Embryo vix curvatus cotyledonibus brevibus contrariis.

Globose, or mostly ovate; simple, or mostly branching from the base or cespitose; tubercles forming few or mostly a great many ribs; bunches of short or long spines, distant or approximate, often very crowded; vertex never woolly; flowers lateral, produced from last year's growth, opening only in sunshine, but for two or three days in succession; closed at night, or in dark weather.

[8] ECHINOCEREUS VIRIDIFLORUS, n. sp.: ovato-globosus, humilis, sub-13-costatus; areolis lanceolatis, approximatis, junioribus villosis; aculeis 16–18 rectis, radiantibus, lateralibus longioribus fuscis, reliquis albidis, centrali nullo s. elongato robusto, apice fusco; floribus lateralibus; tubo pulvillis 25–30 albo-tomentosis setas albas 5–10 gerentibus stipato; sepalis interioribus lineari-oblongis sub-10; petalis 12–15 lineari-oblongis, obtusis; baccis ellipticis virescentibus, seminibus parvis tuberculatis.

Prairies on Wolf Creek, flowers in June; Santa Fé, flowers in May (Fendler). Body 1 to 1½ inch high, oval; spines 1 or 1½ to 3 lines long; central spine when present 6 to 7 lines long; flower 1 inch long and wide, outside green brown, inside yellowish green; petals only 2 lines wide, being about 5 lines long.

* This "seems to be *Geranium Fremontii* (Torr.) of Fremont's second report," according to Dr. Torrey, in a note appended by Wislizenus; but in Watson's Index (p. 151) it is said to be synonymous with *G. Richardsoni*. — EDS.

A careful examination of the seeds of numerous *Cactaceæ*, has indicated to me two principal divisions in that family: 1. Cotyledons, more or less distinct, directed with their edges to the edge (or towards the umbilicus), and with their faces to the flattened side of the seed; when curved, accumbent. 2. Cotyledons, mostly very distinct, foliaceous, directed with their edges to the faces, and with their faces to the edges of the seed (or towards the umbilicus); when curved, incumbent, and often circular or spiral.

The first class comprises *Mamillaria*, with a straight embryo; and doubtless, also, [92 (8)] *Melocactus*, seeds of which, however, have not been examined by me; and *Echinocactus*, mostly with a curved embryo. The second class includes *Echinocereus*, with a nearly straight embryo, and very short cotyledons; *Cereus*, with a curved embryo, and foliaceous incumbent cotyledons (probably also *Echinopsis* and *Pilocereus*, and perhaps *Phyllocactus* and *Epiphyllum*); *Opuntia*, with a circular or spiral embryo (circular and with a larger albumen in all *Opuntiæ cylindraceæ*; spiral and with a much smaller albumen in all *Opuntiæ ellipticæ* examined by me), and very large cotyledons. *Rhipsalis* and *Pereskia* may also belong here, but were out of my reach.

The flowers of all the species belonging to the first class, with the exception of some *Mamillariæ*, make their appearance on the growth of the same year. Those of the second class produce the flowers always upon the growth of the next preceding or former years. The first class may, therefore, be distinguished by the name of *Cactaceæ parallelæ* (from the direction of the cotyledons), or *C. apici floræ* (from the position of the flowers). The second class can be named, in a corresponding manner, *Cactaceæ contrariæ, or C. laterifloræ.*

Echinocereus is principally distinguished from *Cereus* proper by its low growth; its short, more or less oval stems, which are frequently branching at base, and thereby cespitose; by the diurnal flowers, with short tubes; by the nearly straight embryo, with short cotyledons. From *Echinopsis*, to which some species have been referred, it differs also by the short-tubed diurnal flowers, and by the numerous filaments being adnate to the lower part of the tube. For further particulars compare the note 7. The species of *Echinocereus* inhabit Texas and the northern parts of Mexico, where *Cerei* proper are very rare. They extend even farther north than the *Echinocacti;* but appear to be excluded from the old limits of the United States, where the cactus family is represented only by some *Opuntiæ* and *Mamillariæ*. The southern limits of the *Echinocerei* are unknown to me, but I doubt whether they extend far in that direction; the nearly-related *Echinopses*, on the contrary, appear to be exclusively inhabitants of South America, especially the La Plata countries.

As I am speaking of the geographical distribution of the *Cactaceæ*, I may as well add here that *Mamillariæ* were found throughout the whole extent of Dr. Wislizenus's tour, and that at least four species occur in Texas. *Echinocacti* were observed only south of Santa Fé, and from there to Matamoros, but none on the highest mountains, which were occupied by *Opuntiæ, Mamillariæ*, and *Echinocerei;* two *Echinocacti* have been found in Texas. Only two species of true *Cerei* were seen; one of a peculiar type about Chihuahua, and another near the mouth of the Rio Grande, which does not appear to differ from the wide-spread *C. variabilis*, Pfeiff. *Opuntiæ ellipticæ*, as well as *cylindraceæ*, were observed from New Mexico to Matamoros, and species of both are also found in Texas. *Melocacti, Phyllocacti*, and other genera of *Cactaceæ*, not mentioned above, were not met with.

The notes and collections of Dr. Wislizenus confirm the opinion of that acute observer and successful cultivator of *Cactaceæ*, Prince Salm-Dyck, viz.: that most species of this family have a very limited geographical range, the most striking exception being those belonging to the genus *Opuntia*.

On the same day two other species of *Echinocereus* were found in pine timber, both [93 (9)] with beautiful deep red flowers.[9] We shall have occasion to speak of others hereafter.

[9] ECHINOCEREUS TRIGLOCHIDIATUS, n. sp.: ovato-cylindricus, 6–7-costatus, costis undulatis acutis; areolis sparsis, orbiculatis, junioribus albo-lanatis; aculeis 3–6, plerumque 3, rectis compressis angulatis, cinereis, sub-deflexis;

After leaving Santa Fé, Dr. Wislizenus directed his course southward along the Rio Grande. The country was partly mountainous and rocky; partly, and principally along the river, sandy; on an average between 4,000 and 5,000 feet above the ocean. Here we find again some of the plants of the plains and of Texas, as *Polanisia trachysperma*, T. and G.; *Hoffmanseggia Jamesii*, T. and G. An interesting *Prosopis* with screw-shaped legumes nearly allied to *P. odorata*, Torr. and Frem., of California, was the first shrubby mimoseous plant observed during the journey, a tribe which hereafter becomes more and more abundant; *Mentzelia* sp. *Cosmidium gracile*, *Eustoma*, *Heliotropium currasavicum*, *Maurandia antirrhiniflora*, a beautiful large flowered *Datura*, *Abronia*, *Hendecandra Texensis*, and many others. Near Olla the first specimens appeared of a new species of *Larrea*,[10] the first and most northern form of the shrubby *Zygophyllaceæ*, more abundant [94 (10)] farther south. In the same neighborhood the mezquite tree or shrub was first met with, probably *Algarobia glandulosa*, T. and G. From here the mezquite was abundantly found down to Matamoros, but the specimens collected appear to indicate that there are at least two different species.

On the next day, near Sabino, an interesting bignoniaceous shrub was collected for the first time, undoubtedly the *Chilopsis* of Don, which farther south appears more abundantly. Its slightly twining branches, willow-like slender glutinous leaves, and large paler or darker red flowers, render it a very remarkable shrub. Dr. Gregg mentions it under the name of "*Mimbre*," as one of the most beautiful shrubs of northern Mexico. The character given by Don, and that of De Candolle, appear defective, though I cannot doubt that both had our plant in view. From the very com-

floribus lateralibus, tubo pulvillis 15–20 albo-tomentosis setas spinosas apice fuscas 2–5 gerentibus stipato; sepalis interioribus sub-12 oblongo-linearibus obtusis; petalis 12–15 obovatis obtusis; staminibus petala subæquantibus; stigmatibus 8–10 virescentibus.

On Wolf Creek, in pine woods, flowers in June; Santa Fé (Fendler) 4 to 6 inches high, 2 to 2½ in diameter; spines in young specimens 4 to 6, in older ones generally 3, two lateral ones 8 to 14 lines long, one bent down only 6 to 8 lines long. Flowers 2 to 2½ inches long, 2 inches in diameter; setose spines of tube 3 to 6 or 7 lines long; petals deep crimson, 6 to 7 lines wide; filaments and anthers red. In specimens from Santa Fé, collected by Mr. Fendler, the flowers are near 3 inches long, the petals 8 to 9 lines wide, and the setae on the tube are spinous, with brownish points.

Echinocereus coccineus, n. sp.: globoso ovatus, 9–11 costatus, costis tuberculosis subinterruptis; areolis ovatis junioribus albo-tomentosis; aculeis radialibus 9–10 albidis, rectis, oblique porrectis, superioribus brevioribus; centralibus 1–3 longioribus albidis s. corneis; floribus lateralibus; tubo pulvillis 18–25 albo-tomentosis, setas tenues albidas 8–11 gerentibus stipato; sepalis interioribus 8–10 oblongo linearibus obtusis; petalis 10–12 obovatis obtusis; staminibus brevioribus; stigmatibus 6–8 virescentibus.

With the foregoing, also about Santa Fé. — Only 1½ to 2 inches high, 1¼ to 1½ inch in diameter; like most other species of this genus, either single or generally branching from the base and cespitose, sometimes forming clusters of 10 to 15 heads. Spines terete all more or less erect, none appressed as in many other species; radiating ones 3 to 6, central ones 8 to 10 lines long. Flowers 1½ to 1¾ inch long, and 1 to 1½ wide when fully expanded; bristles of tube 3 to 6 lines long; petals deep crimson 4 to 5 lines wide; filaments red, anthers red or yellow. The flowers resemble much those of the last species, but the plant is very different.

[10] Larrea glutinosa, n. sp.: divaricato-ramosissima, ad nodos glutinosa; foliis breviter petiolatis, bifoliolatis, foliolis oblique ovatis mucronatis, nervosis, coriaceis, adpresse pilosis glutinosis; floribus inter folia opposita solitariis; fructu 5-cocco villoso.

Common from Olla and Fray Cristobal, in New Mexico, to Chihuahua and Saltillo; also about Presidio (Dr. Gregg); flowers in March and April; fruit ripe in July. Shrub 5 to 8 feet high, very much branched, very glutinous; used as a sudorific and diuretic, and called *gobernadora*, or in the north *guamis*, according to Dr. Gregg. Leaflets 3 to 6 lines long and half as wide, cuspidate or mucronate; ovary 5-celled, each cell with 3 or 4 ovules; fruit 3 lines in diameter, globose, attenuated at base; seeds by abortion only one in each cell, falcate, smooth, shining.*

* This "seems to be *Larrea Mexicana* of Moricand, described and figured in a work to which Dr. E. had not access," according to Dr. Torrey, in a note appended to the paper by Wislizenus. — Eds.

plete specimens obtained both by Dr. Wislizenus and Dr. Gregg, I am enabled to correct those errors.[11]

Near Albuquerque a curious *Opuntia* was observed; it evidently belongs to *Opuntiæ cylindraceæ*, but has short clavate joints, which make the name of *O. clavata*[12] most [95 (11)] appropriate. A singular plant, with the habit of a *Ranunculus*, but nearly related to *Saururus*, was also found in this neighborhood among grass on the banks of the Rio Grande. The genus has been described by Nuttall from specimens collected by him in California, but whether his *Anemopsis Californica* is specifically identical with the New Mexican plant, remains to be seen, as this last has regularly 6 leaved involucres, about 6 stamens, and is perfectly glabrous.

While the last mentioned plants indicate that we approach another botanical region, we are surprised to meet here with *Polygonum amphibium*, common in the Old and in the New World, and *Cephalanthus occidentalis*, so widely diffused in the United States.

The famous desert, the Jornada del Muerto, furnished, as was to be expected, its quota of interesting plants. A *Cruciferа* near *Biscutella*, of Europe, but with very short styles and white flowers, was here met with abundantly. I had considered it as the type of a new genus, when I found in Hooker's London Journal of Botany of February, 1845, Harvey's description of his new Californian genus *Dithyrea*,[13] which probably must be made to embrace our plant as a second species.

A new species of *Talinum*, with single axillary flowers, was found for the first time [96 (12)] in the Jornada, but was again collected further south, towards Chihuahua. *Dalea lanata*,

[11] CHILOPSIS, Don, char. emend. Calyx ovatus plus minusve bilobus, lobo altero breviter 3-, altero 2-dentato; corolla basi tubulosa curvata, fauce dilatata campanulata, limbo 5-lobo, crispato-crenato; stamina 4 fertilia didynama, antherarum nudarum lobis ovatis, obtusis; quintum sterile brevius nudum; ovarium ovatum; stylus filiformis; stigma bilamellatum; capsula siliquæformis, elongata, bilocularis, septo contrario placentifero; semina transversa margine utroque comosa.

An erect Mexican shrub, 8 to 12 feet high, ends of branches often slightly twining; branches smooth, and glutinous or rarely woolly; lower leaves somewhat opposite, upper ones sparse, lanceolate-linear, long-acuminate, glabrous or glutinous; racemes compound, terminal, pubescent; pedicels bracted, corolla rose colored or deeper red or purple.

Along water-courses or in ravines, from Sabino, near Albuquerque to Chihuahua, Saltillo and Monterey. Leaves 2 to 4 inches long, 1 to 3 lines wide; flowers 1¼ to 1½ inch long; fruit 6 to 10 inches long; seeds with the coma 6 lines long.

There are perhaps two species: one from the neighborhood of Saltillo, with larger, paler flowers, broader, not glutinous leaves, and woolly branchlets, perhaps the *Ch. saligna* Don; the other from New Mexico and Chihuahua, with longer, narrower glutinous leaves, perfectly glabrous, glutinous branchlets, and darker and smaller flowers, may be *Ch. linearis*, DC., or a new species, *Ch. glutinosa*. The calyx is variable in both.

[12] OPUNTIA CLAVATA, n. sp.: prostrata, ramulis ascendentibus, obovato-clavatis, tuberculatis; areolis orbiculatis albo-tomentosis, margine superiore setas albas spinescentes gerentibus; aculeis albis complanatis, radiantibus, 6–12 minoribus, centralibus 4–7 majoribus, longioribus deflexis; floribus terminalibus; areolis ovarii 30–45 -[50] albo-tomentosis, setas albas 10–15 gerentibus; sepalis interioribus ovato-lanceolatis acuminatis s. cuspidatis; petalis obtusis, erosis, sæpius mucronatis; stigmatibus 7–10 brevibus erectis; bacca elongato-clavata, profunde umbilicata, setaceo-spinosa.

About Albuquerque (W.), about Santa Fé, on the high plains, never on the mountains (Fendler). Mr. Fendler informs me that the ascending joints sprout from or near their base, and that in this manner they finally form a large spreading mass, often 2 and even 4 feet in diameter, to which the white shining spines give a very pretty appearance. Joints or branchlets 1½ to 2 inches long, tubercles at their base smaller, with shorter spines, towards the upper and thicker end larger, with stouter and longer spines; radial spines 2 to 4, central ones from 4 to 9 or 10 lines long; ovary 15 lines long, flower yellow, 2 inches in diameter; stigmas only 1½ line long; fruit apparently dry and spiny, 1½ to 1¾ inch long; seeds smoother than those of most other *Opuntiæ*, rostrate, with a circular embryo. Apparently near *Opuntiæ platyacanthæ*, Salm.; but the tuberculated joints and the shape of the embryo approach it closely to *O. cylindraceæ*.

[13] DITHYREA, Harv., char. emendat. Sepala 4, basi aequalia, oblongo-linearia. Petala 4 spathulata, basi ampliata. Stamina 6 tetradynama, libera, edentula. Stylus brevissimus: stigma incrassatum. Silicula sessilis, biscutata, basi et

Centaurea americana, *Sapindus marginata*, and a *Bolivaria*, probably identical with a new Texan species, brought to mind the flora of Arkansas and Texas, while the gigantic *Echinocactus Wislizeni*,[14] reminds us again that we are approaching the Mexican plateau. This enor- [97 (13)] mous cactus attained generally a height of 1½ to 2 feet; specimens 3 feet high were rare, but one specimen was found which measured 4 feet in height, and near 7 feet in circumference; its top was covered with buds, flowers, and fruits, in all stages of development. In size it ranges next to *Echinocactus ingens*, Zucc., specimens of which 5 to 6 feet high were collected near Zimapan, in Mexico. Another Mexican cactus, *E. platyceras*, Lem., is said to grow 6, and even 10 feet high, and proportionately thick. *E. Wislizeni* is therefore the third in size in this genus.

From the same neighborhood a beautiful *Mamillaria* was sent in dried, as well as living specimens. It appears to be one of the few *Mamillariæ longimammæ*, though it differs in having purple, not yellow flowers, and stiffer spines. By the name I have given it, *M. macromeris*,[15] I intended to indicate the unusually large size of different parts of the plant, the tubercles, the spines, and the flowers.

apice emarginata, a latere plano-compressa. Semina in loculis solitaria, compressa, immarginata, horizontalia. Cotyledones planæ radiculæ descendenti septum spectanti accumbentes.

Annual (all?) plants of California and New Mexico, with stellate pubescence, repando-dentate leaves, yellow(?) or white flowers in simple terminal racemes.

DITHYREA WISLIZENI, n. sp.: erecta incano-pubescens ramosa, foliis breviter petiolatis repando-dentatis, racemo umbelliformi, demum laxo elongato; pedicellis eglandulosis, horizontalibus flore longioribus, sepalis calycis aperti patulis; petalis (albis) obovatis, unguiculatis basi dilatata sub-cordatis; stigmate cordato conico; siliculis basi profundius emarginatis.

Common in sandy soil near Valverde and Fray Cristobal, north of the Jornada del Muerto; flowers in July. Plant about 1 foot high, annual or biennial; leaves ovate lanceolate, attenuate in the short petioles, closely resembling those of some species of *Gaura;* pedicels filiform, longer than the flower or fruit; flowers white, about 3 lines in diameter, open; petals obovate, with a long and distinct claw, which is widened at base; filaments also thickened at base; ovary tomentose; style hardly visible, more distinct in the fruit, which is 5 to 6 lines in transverse diameter, and about half as much from base to top; the valves appear to be closed at their attachment to the subulate solid dissepiment.

DITHYREA CALIFORNICA, Harv.: pedicellis basi bi-glandulosis horizontalibus, flore multo brevioribus; sepalis calycis cylindrici clausi erectis; petalis (aureis?) lineari-spathulatis; stigmate bilobo; siliculis apice profundius emarginatis.

Easily distinguished by the characters just enumerated from the New Mexican plant; though the difference in calyx and stigma will not permit a generic separation.

[14] ECHINOCACTUS WISLIZENI, n. sp.: giganteus, vertice villoso-tomentoso; costis . . . acutis crenatis; areolis oblongis, approximatis, junioribus fulvo-tomentosis; aculeis radialibus flavis, demum cinereis, porrectis; lateralibus sub-15 setaceis elongatis læviusculis, summis infimisque 5–6 brevioribus robustioribus, annulatis; centralibus rubellis annulatis, 3 rectis sursum versis, 1 inferiore robustissimo, supra plano, apice reflexo-hamato; floribus sub verticalibus, ovario et tubo brevi campanulato sepalis imbricatis, auriculato-cordatis 60–80 stipato; sepalis interioribus 25–30 ovatis obtusis; petalis lanceolatis mucronatis, crenulatis; stylo supra stamina numerosissima brevia longe exserto; stigmatibus filiformibus 18–20 erectis; bacca ovata, lignosa, imbricato-squamosa.

Near Doñana, collected in August with buds, open flowers, young and ripe fruits on the same specimen. It belongs therefore to those *Echinocacti* which flower through the whole season, like *E. setispinus*, Engelm., (in Plant. Lindh.) of Texas, while others are in flower only during a week or two in spring, e. g. *E. Texensis*, Hpfr. In the latter, the young bunches of spines, together with the flower buds in their axils, come out at once in spring, and none more are formed during the season, while in the first they are gradually developed during the whole season. Plant 1½ to 4 feet high; oval, with a smaller diameter. Areolæ 6 to 9 lines long, only 6 lines distant from one another; radial spines 1½ to 2 inches long; straight central ones 1¼ to 1½, and large hooked ones 2 to 2½ inches long; yellow flowers 2 to 2½ inches in length, campanulate; fruit 1¼ to 1½ inch long, topped with the remnants of the flower of the same length; seeds black, rough, obliquely oval, with considerable albumen, in which the curved cotyledons are partly buried.

[15] MAMILLARIA MACROMERIS, n. sp.: simplex, ovata, tuberculis laxis, e basi latiore elongatis cylindricis, incurvis, sulcatis; areolis junioribus albo-tomentosis; aculeis angulatis rectis, elongatis, omnibus porrectis; radialibus sub-12

In the same region a strange plant was obtained for the first time, but then without flowers or fruit, and which, to the casual observer, appeared as curious as it is puzzling to the scientific botanist; single spiny sticks or stems having a soft and brittle wood, and a great deal of pith in the centre, one or more from the same root, but always without branches, 8 to 10 feet high, not more than half an inch thick, frequently overtopping the brush among which they were found, only towards the top with a few bunches of already yellow leaves. In the following spring the splendid crimson flowers of this plant were found by Dr. W. between Chihuahua and Parras, and to Dr. Gregg I am indebted for mature fruit, collected near Saltillo and Monterey. The plant proved to be a *Fouquiera*, two species of which had been found in Mexico by Humboldt; one of them, the *F. formosa*, a branching shrub, was only known in the flowering state; the other, *F. spinosa*, a spinous tree, only in fruit. The structure of the ovary of the first appeared to differ so much from that of the capsule of the second, that it was afterwards deemed necessary to distinguish both generically, and the second constituted then the genus *Bronnia*. Having both flowers and fruit of a third *Fouquiera*, I am enabled to solve the difficulty to some extent, and prove the neces- [98 (14)] sity of reuniting *Bronnia* with *Fouquiera*.[16] The flower of *Fouquiera splendens*, as I have named the northern plant, is that of a true *Fouquiera*, while the fruit is nearly that of *Bronnia!*

tenuioribus, albidis; centralibus sub-3 robustioribus, longioribus, fuscis; floribus maximis, roseis; sepalis ovatis, acutis, fimbriatis; petalis mucronatis, fimbriatis; stylo supra stamina brevia longe exserto, stigmatibus 8.

Sandy soil near Doñana, in flower in August. All my specimens single; trunk oval, 1 to 2 inches high; tubercles in 8 rows, 12 to 15 lines long, incurved; groove at first tomentose down to the tomentose supra-axillary areola; radial spines 1 to 1½, central 1½ to 2 inches long; flowers 2½ to 3 inches in length and diameter, probably larger than in any other species of this genus; petals rose-colored, darker red in the middle.

[16] FOUQUIERA, Humb. B. Kunth, charact. emendat. Calyx 5-sepalus, imbricatus, persistens. Corolla hypogyna, gamopetala, longe-tubulosa, limbo brevi 5-partito, patente, æstivatione incomplete contorta. Stamina 10–15, hypogyna, exserta; filamenta inferne arcuata villosa, basi inter se cohærentia; antheræ biloculares, longitudinaliter dehiscentes, mucronatæ, basi cordatæ, imo dorso affixæ, introrsæ. Ovarium liberum sessile; placentæ 3 parietales ad centrum productæ neque connatæ, ovarium inde incomplete triloculare; ovula sub-18 ascendentia, in quaque placenta 6 biseriata; stylus filiformis trifidus. Capsula coriacea trivalvis; valvæ medio placentiferæ; placentæ demum margine centrali connatæ et a valvis solutæ placentam singulam centralem triangularem formantes. Semina 3–6 complanata, alata s. comosa; albumen tenuissimum membranaceum; embryo magnus rectus, cotyledonibus planis, radicula breviori infera.

Mexican shrubs or trees, with soft fragile wood, and tuberculated, angular branches, the tubercles bearing spines, and in their axils single or fasciculate obovate entire leaves; splendid crimson flowers in terminal or subterminal spikes or panicles. At present only the following species of this genus are known:

1. F. FORMOSA, HBK.: fruticosa, spinis brevissimis, foliis solitariis oblongis subcarnosis; floribus sessilibus arcte spicatis, staminibus 12; stylo apice tripartito.

2. F. SPLENDENS, n. sp.: fruticosa, simplex, spinis longioribus, foliis fasciculatis, obovato-spathulatis, membranaceis; floribus breviter pedicellatis in paniculam thyrsoideam congestis, staminibus 15; stylo ultra medium tripartito, seminibus 3–6 comosis.

3. F. SPINOSA, HBK.: arborea, ramosa, spinis longioribus, foliis plerumque fasciculatis, obovato-oblongis, membranaceis; floribus pedicellatis corymboso-paniculatis; staminibus 10; seminibus 3 membranaceo-alatis.

Fouquiera splendens is a common plant from the Jornada del Muerto, in New Mexico, to Chihuahua, Saltillo, and Monterey; flowers in April, fruit by the end of May.

A general description has already been given in the text. In New Mexico it was seen only 8 or 10 feet high, but farther south it was found from 10 to 20 feet high, and in favorable localities it is said to grow even 30 feet high, and rarely thicker than about one inch in diameter. Bark smooth and ashy gray; spines horizontal, slightly curved, 6 to 10 lines long, disappearing on old stems; leaves deciduous fascicled in the axils of the spines towards the top of the stem, short-petioled, spathulate, obtuse, membranaceous, glabrous, somewhat glaucous, 9 to 12 lines long, and 3 to 4 lines wide; panicles from the upper fascicles of leaves, near the top, one or several, erect, crowded, 4 to 6 inches long; pedicels bracted, longer than the yellowish chartaceous calyx; sepals orbicular 2 lines long; corolla scarlet 9 to 10 lines long; filaments at base slightly cohering with one another, and with the base of the corolla, villous below and with a small horizontal process, which forms an arch over the ovary. Placentæ in the ovary lateral, 3, bearing each 6 ascending acute ovula, at the inner margin, where they appear to touch one another without being actually united

Towards El Paso a curious capparidaceous plant was collected, which appears to be nearly allied to the Californian *Oxystylis* of Torrey and Fremont, and forms with it a distinct group in that family, approaching very closely to *Cruciferæ*, as has been remarked by Professor Torrey.

I have named this new genus (in honor of its discoverer, who has, though unaided and often embarrassed in different ways, done so much towards the advancement of our knowledge of those northern provinces of Mexico — the first naturalist, it is believed, who explored [99 (15)] the regions between Santa Fé, Chihuahua, and Saltillo) *Wislizenia !*[17] From *Oxystylis* it is principally distinguished by its long stipitate ovary and capsule, which latter is reflexed, and by the elongated racemes; it may, however, have to be united with that genus.

On the mountains about El Paso, another of those cylindraceous *Opuntiæ* was found, but much thinner and more slender than both species mentioned previously. To judge from an imperfect description, it must be nearly related to the Mexican *O. virgata,* Hort. Vind. I have given it the name of *O. vaginata,*[18] as the straw-colored loose sheaths of the long spines [100 (16)] are very remarkable. A new *Echinocereus* was also collected here, which, on account of its dense covering with small spines, I have named *E. dasyacanthus.*[19] I have in cultivation one of

at that stage of the growth. Soon after they probably adhere in the centre to each other, and towards the ripening of the capsule detach themselves from the valves, presenting a free central triangular spongy placenta, with about 6 (or by abortion less) seeds. Capsule coriaceous oval, acutish, light brown, about 6 lines long. Seeds compressed, integument expanded in a wing, which is cordate at the upper end, and finally resolves itself into a coma of silky fibres. If my view of the ovary and fruit of this plant is correct, the ovary is 1-celled, with 3 lateral placentæ — that of a true *Fouquiera,* the ripe capsule is 1-celled, with one central placenta — that of *Bronnia,* and the unripe fruit must be 3-celled! *Fouquiera splendens* grows readily from cuts, and is used about Chihuahua for hedges and fences.

[17] WISLIZENIA, n. gen. Sepala 4; petala 4 oblonga, breviter unguiculata; stamina 6 toro cylindrico inserta; filamenta filiformia longe exserta æstivatione inflexa; ovarium longe stipitatum, globose didymum, biloculare, loculis 2-ovulatis; stylus subulatus, elongatus, stigma globosum. Capsula siliculæformis, didyma tuberculata cum stipite in pedicellum filiformem refracta, bilocularis, loculis plerumque per abortum 1-spermis; valvæ urceolatæ a dissepimento pertuso solutæ, semen includente; semen conduplicato-reniforme, læve; cotyledones radiculæ superæ incumbentes.

A glabrous New Mexican annual, much branched, of the habit of *Cleomella,* with ternate leaves, distinct laciniate-fimbriate stipules, and bracted at last elongated racemes, small yellow flowers; fruit reflexed, stipe with the equally long (not spinous) style, and the small dissepiment persistent after the falling off of the valves.

W. REFRACTA, n. sp. On the upper crossing of the Rio Grande, near El Paso; flowers and fruit in August. An interesting and quite anomalous plant, on account of its fruit with an almost complete dissepiment, and of its stipules and bracts. Tuberculated valves of the capsule separating from the placentæ, and though open, retaining the only (rarely two) seed-placentæ forming a complete dissepiment, which, in the perfectly ripe and dry state, finally becomes perforated in the centre.

[18] OPUNTIA VAGINATA, n. sp.: caule lignoso, erecto, ramulis teretibus vix tuberculatis; areolis orbiculatis, albo-tomentosis, margine superiore fasciculum setarum brevium fuscarum, inferiore aculeum elongatum corneum vagina laxa straminea involutum, deflexum gerentibus; floribus parvis, ovario obovato, areolis 13 tomentosis setigeris stipato; sepalis interioribus 8 et petalis 5 obovatis mucronatis; bacca obovata profunde umbilicata, carnosa, aurantiaca; seminibus paucis.

On the mountains near El Paso; in August in flower and fruit. Belongs to *Opuntiæ cylindraceæ graciliores* (Salm-Dyck); perhaps nearest to *O. virgata,* H. V., but distinguished by the longer deflexed spines. Apparently 3 or 4 feet high; ultimate branches 2½ to 3 lines in diameter; spines single, 1½ to 2 inches long, rarely with a second smaller one, straight, more or less deflexed; epidermal sheath yellow or brownish, very loose, at last coming off; ovary 4 to 5 lines long; flower 6 to 9 lines in diameter, pale yellow, with a greenish tinge; stigma conic, with 5 adpressed segments; fruit 7 to 8 lines long.

[19] ECHINOCEREUS DASYACANTHUS, n. sp.: ovato-oblongus, s. subcylindricus, 17–18 costatus, costis tuberculatis subinterruptis, areolis approximatis, ovato-lanceolatis, junioribus albo-villosis; aculeis albidis, junioribus apice rufidis, radialibus sub-18 porrectis, summis brevioribus tenuioribus, lateralibus inferioribusque longioribus; centralibus 4–6 pluribus deflexis.

El Paso del Norte. The specimen before me — one of the largest — is 12 inches high, and 3½ inches below and 2 inches above in diameter; wool on the young areolæ unusually long, deciduous; upper spines 3 lines long,

the largest specimens seen by Dr. Wislizenus, which is one foot high. In this neighborhood *Opuntia Tuna*, Mill., was seen for the first time; and this is perhaps the most northern limit of that extensively diffused species, as well as of *Agave Americana*, another common Mexican plant. Both were found in greater perfection near Chihuahua, and from there constantly down to Monterey and the mouth of the Rio Grande. The *Opuntia* appears to extend also high up in Texas.

Together with these a *Dasylirion*, perhaps the same as the Texan species, was found here, and afterwards again near Saltillo.

From El Paso to Chihuahua the road lies in part through a dreadfully arid sand-hill district, where a peculiar *Martynia*[20] was observed, and farther on through a lovely [101 (17)] country, which at that season (August), after the annual rains, was covered with a luxuriant vegetation. The elevation of the country is here between 4,000 and 5,000 feet above the gulf.

The rare *Cevallia sinuata*, which Dr. Gregg has also sent from Monterey, was found in this part of the journey. Here also occurred a perennial species of *Linum*, with yellow petals, — so far, in America, the only perennial yellow-flowering *Linum*; it is distinguished by its long aristate sepals, whence the name.[21] Several *Œnotheræ*, not seen before, made now their appearance; different species of *Gilia*, a number of *Nyctagineæ*, several *Asclepiadaceæ*, *Malvaceæ*, *Cucurbitaceæ*, *Compositæ*, and others, were here collected; including a number of new species, which only want of time and references have for the present prevented me from describing. Near Lake Encinillas another *Martynia*[22] was found, which in its foliage comes nearer to *M. proboscidea*, but is readily distinguished by its purple flowers. A beautiful yellow-flowering bignoniaceous shrub, — probably *Tecoma stans*, Juss., — seen more frequently farther south, was observed for the first time near Gallejo Spring. Shrubby *Algarobiæ* were seen more plentifully, as also some other *Mimoseæ*.

Here would be the proper place to introduce a notice of the several species of *Yucca* found by Dr. Wislizenus; but unfortunately the labels of the specimens were partly lost, so that it is impossible at this time to arrange leaves, flowers, and fruits properly. Certain it is that several species besides *Yucca angustifolia*, mentioned above, were seen; that the leaves of all of them have filamentose edges, some with very fine, others with very coarse fibres on their margin; that the majority bear juiceless capsules with very thin, paper-like seeds, but that one species produces an

lower lateral ones slightly compressed 6 to 7 lines long, lowest 5 lines long; central spines nearly as long as the last, stouter than the others. From *E. pectinatus* and *E. cæspitosus* (see note 45), which it resembles, it is distinguished by the longer, not appressed spines, the larger number and size of the central spines, etc.

[20] MARTYNIA ARENARIA, n. sp.: annua, glanduloso-pilosa foliis alternis, longe petiolatis, cordatis, 3–5–7-lobatis, lobis rotundatis, repando-denticulatis; bracteis lanceolatis calycem obliquum, infra fissum, dimidium æquantibus; staminibus 4; rostro pericarpium æquante.

Sandhills below El Paso, flowers August. Leaves 1½ to 2 inches wide and long; flowers spotted, "yellow" (Dr. Wislizenus), a little smaller than in *M. proboscidea*.

[21] LINUM ARISTATUM, n. sp.: caulibus e rhizomate ligneo pluribus, ramosissimis, angulatis; foliis sparsis subulatis, aristatis, superioribus bracteisque denticulatis; sepalis lanceolato-linearibus trinerviis, aristatis, margine membranaceo glanduloso-denticulatis; petalis (flavis) calycem sub-duplo superantibus; stylis coalitis; capsula ovata, acuta, sepalis persistentibus bis breviore.

In sandy soil near Carizal, south of El Paso; collected in August, in flower and fruit. The rhizoma in the specimen before me is 6 inches long and 3 to 4 lines in diameter, white; stems numerous, 1 to 3 feet high, divaricately branched; upper leaves (lower not seen) 3 to 4 lines long; flowers 10 lines in diameter; sepals 4 lines long; petals sulphur yellow; styles united for about three-fourths of their length; capsule 2 lines long.

[22] MARTYNIA VIOLACEA, n. sp.: annua, foliis alternis, cordatis, repando-sinuatis, acutedenticulatis, glabriusculis; bracteis lanceolatis calyce obliquo, infra usque ad basin fisso, dimidio brevioribus; staminibus 4; rostro pericarpium superante.

Near Lake Encinillas, north of Chihuahua; flowers August; leaves 4 to 6 inches long, and nearly as wide, indistinctly sinuate-lobed, beset with small, sharp, distant teeth; flowers from pale red to deep violet purple, as large as in *M. proboscidea*.

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edible succulent fruit with very thick seeds. Fortunately, the seeds collected by [102 (18)] Dr. Wislizenus arrived here in the best condition, and some have already germinated, so that we may hope to raise some of these species. *Yucca aloëfolia*, of the Southern United States and Mexico, is said also to bear an edible fruit, but has serrulate leaves. We have therefore different species of *Yucca* with edible fruits, which may constitute a peculiar section in this genus.

The soil appeared to be too fertile here for the production of *Cacti;* and, with the exception of some *Opuntiæ*, the only species collected between Paso and Chihuahua — about one hundred miles south of the former place — was *Cereus Greggii*,[23] which was peculiarly interesting, as it is probably the most northern form of *Cereus* proper. The specimens sent for cultivation by Dr. Wislizenus were unfortunately dead when they arrived here, and neither flower nor fruit had been obtained; but Dr. Gregg has collected the same species near Cadena, south of Chihuahua, in flower, from which I completed the description. I could not have given it a more appropiate name than that of the zealous and intelligent explorer of those far-off regions. I learn from Prince Salm-Dyck that a *Cereus*, probably the same species, was sent to England by Mr. Potts, of Chihuahua; but his specimens also did not live; they were very remarkable for having a thick turnip-shaped root. Neither Dr. Wislizenus nor Dr. Gregg having paid attention to the root, I am unable to say whether their specimens agreed with those of Mr. Potts in this particular.

Dr. Wislizenus was forced to go from Chihuahua westward to Cosihuiriachi. However prejudicial this involuntary interruption of his journey may have been to the primary objects of his expedition, it appears that he could not have selected a more favorable field for botanical researches. Amongst the porphyry mountains of Cosihuiriachi and Llanos — which vary from 6,000 to 8,000 feet in height — and their deep chasm-like valleys, a great many undescribed species of plants were found; in fact, almost everything collected there appears to be new!

Among the trees, I mention three species of pines, entirely different from those found farther north, but perhaps identical with some species from the Pacific coast. The most magnificent of these three is a species nearly related to *Pinus Strobus* and *Pinus flexilis*, which I name *P. strobiformis*.[24] Its size and growth, its foliage, as well as the shape of the cones, [103 (19)] resemble the common white pine of the north; but the cones are two or three times as large, not to speak of the other differences. It only grows on the highest mountains of this region, of about 8,000 feet elevation, and attains the height of 100 to 130 feet.

Pinus macrophylla,[25] another inhabitant of the higher mountains of Chihuahua, is more common than the last. Like it, it closely resembles a well-known species of the United States, *P.*

[23] CEREUS GREGGII, n. sp.: erectus, ramosus, pentagonus; areolis distantibus oblongis, nigro-tomentosis; aculeis nigris, brevissimis, e basi incrassata subulatis, acutissimis, 6–9 radialibus subrecurvis, infimis longioribus, centrali singulo deflexo minuto; tubo floris elongato, areolis 60–80 cinereo-tomentosis setas 6–12 nigricantes s. apice albidas gerentibus stipato; sepalis interioribus 15–20 et petalis 15–20 lanceolatis, acuminatis, integris.

North and south of Chihuahua; flowers April and May. Stem 1 to 2 feet high, about 6 lines in diameter; spines ½ to 1 line long, extremely sharp; flower about 6 inches long and 2 inches in diameter; bristles of the tube 1½ to 3 lines long; interior sepals reddish green, petals pale purple.

[24] PINUS STROBIFORMIS, n. sp.: squamis turionum ovatis acuminatis; vaginis laxis, patulis, deciduis; foliis quinis filiformibus, supra albo-lineatis, acute carinatis, subtus convexis, margine tenuissime serrulatis; strobilis cylindricis, elongatis, squamis obtusis inermibus, demum recurvis.

Highest peaks about Cosihuiriachi. The largest pine in this region 100 to 130 feet high. Sheaths 6 lines long, very deciduous; leaves 2 to 3½, mostly 3 inches long; cone about 10 inches in length, very resinous. This species forms, with *Pinus Strobus* and *Pinus flexilis*, a peculiar section, distinguished by their five leaves and their cylindric pendulous squarrose cones. The leaves of *P. Strobus* are the most slender, concave on the back, and strongly serrate; those of *P. strobiformis* are somewhat more rigid, convex on the back, and slightly serrate; those of *P. flexilis* are still more rigid, convex on the back, and entire.

[25] PINUS MACROPHYLLA, n. sp.: squamis turionum longe acuminatis, fimbriato laceris, squarrosis, persistentibus; vaginis elongatis, adpressis, laceris; foliis ad apicem ramulorum congestis ternis, quaternis (rarius quinis) longissimis,

australis, from which it differs by its short cones, which have on each scale a mammillary recurved tubercle, and by having the leaves not only in threes, but also in fours and even in fives. It may be near *P. occidentalis* of the interior of Mexico, but that has regularly five leaves in each sheath.

Pinus Chihuahuana,[26] is the common pine of Cosihuiriachi and the mountains of Chihuahua, in general at an elevation of about 7,000 feet. It grows only 30 to 50 feet high, and resembles somewhat *P. variabilis*, though sufficiently distinct. Dr. Wislizenus was unable to obtain specimens of a fourth pine, which is said to grow on the still higher mountains to the west, near Jesus-Maria, bearing cones 15 or 18 inches in length.

On the highest peaks in this region a species of *Arbutus* was found, which the inhabitants call *Matronia*. It is a small tree, with a smooth, red bark, bearing in November and December red edible berries. If it is at all distinct from *A. Menziesii*, Pursh, of the northwest coast, which it closely resembles, it ought, from the color of its bark, to bear the name of *A. sanguinea*. [104 (20)] These, together with a low scrubby oak tree, with small perennial leaves, were the only trees collected about Cosihuiriachi. A species of *Juniperus* with red berries, a *Thuja*, and a small-leaved *Cowania* (?),[27] all of them in fruit, were also brought from there.

Between Chihuahua and Cosihuiriachi, but especially about the latter place, the porphyritic soil produced a number of *Cactaceæ*, some strange *Echinocacti*, several *Mamillariæ*, a few *Opuntiæ*, and principally a great variety of *Echinocerei*. One of the latter is completely covered with stout and long spines;[28] another has short radiating spines, closely adpressed to the plant;[29] a third has short radiating spines, with single stout, black central ones, which project from the plant in all directions;[30] a fourth is distinguished by its longer and curved reddish radiating spines,

margine carinaque serrulatis, utrumque aspero-striatis, subglaucis; strobilis ovato conicis; squamis tuberculo conico, apice spinifero, recurvo instructis; seminibus parvis, alatis.

Common on the higher mountains of Cosihuiriachi; 70 to 80 feet high; sheaths 15 to 20 lines long; leaves 13 to 15 inches long in the specimens before me, in fours as well as in threes, rarely in fives; cone 4½ inches long. Evidently near *P. australis*, Mich., but well distinguished by the characters enumerated.

[26] *Pinus Chihuahuana*, n. sp.: squamis turionum acuminatis, adpressis; vaginis adpressis, elongatis, laceris, deciduis; foliis ternis (rare quaternis) supra glaucis, subtus virescentibus, leviter striatis, margine tenuissime serrulatis; strobilis ovatis, abbreviatis; squamis transverse ovatis, inermibus.

The common pine of the mountains of Chihuahua, at an elevation of about 7,000 feet. A tree of only 30 to 50 feet in height; leaves 2 to 3½ inches long; serrulate on the margin, but with nearly smooth striæ; cone in the specimen before me 1½ inch long.

[27] COWANIA, sp. ? Shrubby; leaves crowded, small, cuneate, three-toothed at apex, revolute, tomentose below; glabrous and glandular above, sweet-scented; turbinate tube of calyx, as well as the oblong lobes, 1 line long; 25 stamens, persistent; about 5 woolly ovaries. — Compare below, note 51.

[28] ECHINOCEREUS POLYACANTHUS, n. sp.: elongato-ovatus, 10-costatus; areolis elevatis, ovatis, subapproximatis, junioribus albido-tomentosis; aculeis radialibus 10–12 flavidis, apice adustis, plus minus porrectis; lateralibus majoribus, demum subadpressis, superioribus minoribus; centralibus sub-4 corneis, apice fuscis, 3 superioribus sursum versis, inferiore singulo longiore porrecto, demum deflexo.

Cosihuiriachi. — Several oval stems, 4 to 5 inches high and 2½ to 3 in diameter, from one base; upper radial spines 4 to 5, lateral and inferior 8 to 10, upper central 9 to 12, lower one 15 to 20 lines long; spines at last ashy-gray.

[29] ECHINOCEREUS ADUSTUS, n. sp.: ovatus, 13-15-costatus; areolis elevatis, lanceolatis, approximatis, junioribus albo-tomentosis; aculeis radialibus 16–18 adpressis, albis, apice adustis; 4–5 superioribus brevibus, setaceis, lateralibus inferioribusque longioribus, robustioribus, centrali nullo.

Cosihuiriachi. — Plant 1½ to 4 inches high, 1 to 2 in diameter: upper spines 1, lower about 2, and lateral 4 to 5 lines long.

[30] ECHINOCEREUS RADIANS, n. sp.: ovatus 13–14-costatus, areolis elevatis, ovatis, subapproximatis, junioribus albo-villosis; aculeis radialibus 16–20 adpressis, junioribus apice adustis, superioribus brevibus setaceis, lateralibus inferioribusque longioribus robustioribus; centrali singulo porrecto, robusto, fusco.

Cosihuiriachi. — 2½ inches high, 2 in diameter; upper radial spines 1 to 2, lower 3, lateral about 5 lines long; central spines brown or black, much stouter, 1 inch long.

with a stouter one projecting from their centre.[31] I have all of these in cultivation, but [105 (21)]
have not seen as yet flowers or fruit from any of them; still they cannot but belong to
my genus *Echinocereus*, to judge from analogy.

Some *Mamillariæ* of Cosihuiriachi are distinguished by their compact shape; the tubercles are very short, globose, or even hemispherical, the spines strong, numerous, radiating, and adpressed, the fruits central from a woolly vertex: *Mamillaria compacta*.[32] Another, *M. gummifera*,[33] belongs, together with two species from Texas and from the mouth of the Rio Grande, to the section *Angulares*, with pyramidal 4-angled tubercles, and milky juice, which, hardening, forms a gum. A third species belongs to *Crinitæ*, and is a most elegant little plant with numerous hair-like
radiating, and one stout, hooked, central spine; I have named it *M. barbata*.[34] The speci- [106 (22)]
men communicated by Dr. Wislizenus, the only one found, was dead when it arrived here,
but many fruits were adhering to the plant, and I was thus fortunate enough to cultivate it from the seeds.

Other remarkable *Cactaceæ* from the State of Chihuahua, which have been communicated to Dr. Wislizenus by Mr. Potts, of Chihuahua, are not described here, as it is believed that Mr. Potts has sent them already to England, where no doubt long before this, they have been published.

Amongst the other distinguished plants of Cosihuiriachi and Llanos, I cannot omit to mention a beautiful *Delphinium*,[35] which grew abundantly here; a *Silene*, which is perhaps new, but comes near to *S. multicaulis*, Nutt., of the Rocky mountains, and *S. Moçiniana*, DC., of Mexico; a new

[31] ECHINOCEREUS RUFISPINUS, n. sp.: elongato-ovatus, 11-costatus; areolis elevatis lanceolatis, approximatis, junioribus albido-villosis; aculeis radialibus 16–18, demum adpressis, intertextis; 3–5 superioribus setaceis, brevibus, albidis; lateralibus elongatis fuscis, recurvis, centrali singulo, robusto, fusco, porrecto.

Cosihuiriachi. — Stem 4 inches high, below 2½ in diameter; upper radial spines or bristles 1 to 2, lower about 4, and lateral 7 to 9 lines long; central spine much stouter, 1 inch long.

[32] MAMILLARIA COMPACTA, n. sp.: simplex, hemisphærica, s. depresso-globosa; tuberculis abbreviatis, ovoideo-conicis, sulcatis; areolis ovato-lanceolatis, junioribus albo-tomentosis; aculeis omnibus radialibus, 13–16 subæqualibus, robustis, recurvatis, adpressis, intertextis, albidis, superioribus apice fuscis; sulcis tuberculorum axillisque junioribus et vertice tomentosis; floribus in vertice congestis; baccis ellipticis perigonio coronatis, viridibus; seminibus obovatis, lævibus, fulvis.

Cosihuiriachi. — Plant 2 to 3½ inches in diameter and 1¼ to 2½ inches high; tubercles in 13 rows, 4 lines high, 6 lines wide at base; spines interlocking, and thereby often deformed and twisted, stout, 7 to 10 lines long.

[33] MAMILLARIA GUMMIFERA, n. sp.: lactiflua, simplex, hemisphærica, tuberculis quadrangulato-pyramidatis; axillis areolisque junioribus albo-tomentosis; aculeis rectis, radialibus 10–12, inferioribus robustis, apice fuscis superiores setaceos albidos ter superantibus; centralibus 1–2 robustis, brevibus, fuscis, porrectis.

Cosihuiriachi. — From 3 to 5 inches in diameter, 2½ to 4 inches high; when wounded it exudes a milky fluid, which, hardening, forms a transparent or whitish gum; tubercles mostly in 13 oblique rows, 6 to 7 lines long, and 5 to 6 lines wide at base; upper spines 2 to 3, lower 6 to 7, central about 2 lines long. Flowers and fruit not seen, but probably like those of two similar species, *M. applanata*, Engelm. ined., from the Pierdenales, in Texas, and *M. hemisphærica*, Engelm. ined., from the mouth of the Rio Grande; both are also simple, lactescent, with pyramidal tubercles, and both have small reddish white flowers, and long clavate scarlet berries, without the remnants of the flower. It is a fact which I have repeatedly observed, and in a considerable number of species, that the red (globose, or clavate) berries of the *Mamillariæ* are always destitute of the remnants of the perigone, etc.; but the (oval) green fruits always are topped with it.

[34] MAMILLARIA BARBATA, n. sp.: simplex, globoso-depressa; tuberculorum axillis nudis; aculeis radialibus numerosissimis pluriserialibus, exterioribus piliformibus albis sub-40; interioribus paulo robustioribus fulvis 10–15, centrali singulo robusto, uncinato, fusco, erecto; baccis oblongis, viridibus, apice floris rudimento coronatis.

Cosihuiriachi. — The only specimen seen was about 2 inches in diameter; tubercles 4 lines long; spines 3 to 4 lines in length; fruit 5 to 6 lines long, in a circle around the younger tubercles; seeds obovate scrobiculate, dark brown, minute.

[35] DELPHINIUM WISLIZENI, n. sp.: perenne, erectum, simplex, glabrum; petiolis elongatis, infimis basi dilatatis;

Bouvardia,[36] which is remarkably distinct from all the other Mexican species of this genus by its smoothness; an *Echeveria* perhaps identical with the Californian *E. cæspitosa*, DC.; several *Gerania*, which appear to be undescribed, one of them with white flowers; an *Eryngium*,[37] with the lowest leaves most elegantly pectinated, and the upper ones pal- [107 (23)] mately divided; a *Zinnia*,[38] intermediate between *Zinnia multiflora* and *Z. elegans*, and which last season grew finely near St. Louis from seeds picked from these specimens. Many other *Compositæ* have not yet been examined; a *Centaurea* may be found to be distinct from *C. Americana*, so far the only American species of that genus, which is so extensively diffused in the Old World.

Leaving aside several *Dalæ*, *Lupini*, *Liliæ*, a *Gentiana*, *Buchnera*, *Castilleia*, a number of *Labiatæ*, *Graminea*, and many others, I will only mention a few more, which I had time to study more closely. First of all, the beautiful and delicate *Heuchera sanguinea*,[39] probably the most southern, and certainly the most ornamental species of that genus. Next in beauty comes the

foliis pedatifide 5–7-partitis, laciniis incisis, segmentis linearibus, acutis, divaricatis; floribus laxe paniculato-racemosis; bracteis subulatis; floribus longe pedicellatis; calcare subulato, curvato sepala paulo superante; sepalis 2 exterioribus **acutis, 3 interioribus obtusissimis; petalis brevioribus acuminatis; ovariis glaberrimis.**

On the Bufa, a porphyry rock near Cosihuiriachi, 8,000 feet high, in flower in September. Stem 2 to 2½ feet high, slender, glabrous, glaucous; flowers sparse, with the spur 1½ inch long, beautifully blue, on the outside slightly puberulent.

[36] BOUVARDIA GLABERRIMA, n. sp.: glaberrima, caule erecto terete; foliis ternatis, breviter petiolatis, ovato-lanceolatis, utrinque acuminatis, patentibus s. reflexis; cyma composita, foliacea; calycis segmentis tubum bis superantibus; **corolla calyce quintuplo s. sexuplo longiore, extus glabriuscula, intus parce barbata.**

Cosihuiriachi, flowers September. Perennial; 2 feet high, leaves 3 to 3½ inches long, 8 to 10 lines wide; flowers bright crimson, 12 to 15 lines long. Apparently one of the largest species of the genus; leaves entirely glabrous, not revolute on the margin.

[37] ERYNGIUM HETEROPHYLLUM, n. sp.: glaberrimum, caule erecto; foliis radicalibus oblanceolato-linearibus, acutis, penni-nerviis, serratis, serraturis cartilagineo-marginatis, aristatis; foliis caulinis inferioribus serrato-pinnatifidis, superioribus palmati-partitis, segmentis linearibus incisis; foliis involucralibus 10–13 linearibus acuminatis, spinoso bidentatis, rarius integris, capitulum ovale longe superantibus; bracteis cœruleis subulatis flores superantibus, **interioribus longioribus.**

Common in valleys about Cosihuiriachi; flowers September. Biennial, 1½ to 2 feet high; radical leaves 2 inches long, 2 lines wide; involucral leaves 12 to 15 lines long, 1 line wide; heads about 4 lines in diameter. Near two other Mexican species, *E. Carlinæ*, Lar., and *E. Hænkei*, Presl., distinguished from the first by the larger number of linear, not ovate serrate involucral leaves; from the other also by the larger number of those leaves which are generally toothed, not entire.

[38] ZINNIA INTERMEDIA, n. sp.: caule erecto, ramoso, parce adpresse piloso; foliis scabris, inferioribus ovatis, basi obtusis, superioribus subsessilibus ovato-cordatis, acutis; pedunculo apice vix incrassato; involucri ovati squamis marginatis obtusis; paleis cristato-fimbriatis; radii ligulis oblanceolatis, extus scabriusculis, ciliatis; acheniis radii **linearibus, disci 1-aristatis.**

Common about Cosihuiriachi, flowers in September. Annual, 1 to 2 feet high; leaves 1 inch long, 6 to 8 lines wide; flowering heads 18 to 20 lines in diameter. The cultivated specimens grew 3 feet high; leaves 3 inches long and half as wide; heads hemispherical, larger, ligulæ less acute. Differs from *Z. multiflora* by the less inflated peduncle, the broader and shorter leaves, the cristate paleæ; from *Z. elegans*, which the shape of the leaves and of the chaff much resembles, by the shape of the achenia. I may state here that in all the cultivated as well as native specimens of *Z. multiflora* **the paleæ are not entire, but fimbriate at the obtuse apex.**

[39] HEUCHERA SANGUINEA, n. sp.: petiolis patenti pilosis; foliis sinu latissimo cordatis, orbiculatis, 5–7-lobatis, lobis incisis duplicatim dentatis, ciliatis; junioribus pilosis; scapo nudo, infra parce piloso, supra cum pedicellis calycibusque colorato glanduloso; floribus laxe-paniculatis campanulatis; calycis lobis ovatis obtusis, subæqualibus; petalis **lineari-spathulatis persistentibus, cum staminibus pistillisque inclusis.**

Porphyry mountains of Llanos, flowers in September. Scape 8 to 12 inches high; upper part, together with the flowers, bright scarlet; enclosed petals inserted below the throat of the calyx; stamens still lower; filaments equal in length to the orbicular cordate red anthers.

bright-flowered *Pentstemon coccineus;*[40] *Lobelia mucronata,*[41] with fine red, and *L. pecti-* [108 (24)]
nata,[42] with blue flowers. Amongst the most curious plants collected here is also to be mentioned an *Eriogonum,*[43] with inflated clavate internodia, and dark red flowers. *Phaseolus bilobatus,* [44] is another interesting plant.

In the following spring Dr. Wislizenus accompanied the Missouri volunteers, under [109 (25)] Colonel Doniphan, from Chihuahua to Parras, Saltillo, Monterey, and Matamoros.

Zealous as ever, he again made large collections on this tour, but his duties as a military surgeon occupied his time rather more than the naturalist should have desired. Nevertheless his

[40] PENTSTEMON COCCINEUS, n. sp.: glaberrimus, glaucus, foliis infimis obovatis, caulinis inferioribus oblongo-linearibus, superioribus linearibus minutis; racemo laxo, pedicellis oppositis, elongatis, 2-bracteatis, 1-floris; calycis glandulosi segmentis ovatis; corollæ tubo superne dilatato, limbo bilabiato, labio superiore ad medium bilobato; antheris divaricatis, filamento sterili glabro, apice dilatato; capsula acuminata.

Llanos, flowers in September and October. Stem 1 to 2 feet high, nearly naked above, pedicels filiform, lower ones much longer than the flower, which is 15 to 18 lines in length; bright scarlet or crimson. Next to *P. imberbis,* Steud., but easily distinguished.

[41] LOBELIA MUCRONATA, n. sp.: perennis, caule simplici erecto, glabro, infra folioso, supra nudo; foliis linearilanceolatis, elongatis, acuminatis, argute denticulatis; floribus laxe spicatis; bracteis linearibus glanduloso-dentatis, inferioribus pedicellum superantibus, superioribus eum æquantibus; calycibus hemisphæricis et pedicellis hirtis; lobis calycis subulatis tubum duplo superantibus, tubum corollæ dimidium æquantibus; lobis corollæ superioribus lanceolatis, inferioribus ovatis mucronatis.

Cosihuiriachi along rivulets; flowers in September. Stem 1 to 2 feet high; racemes short, few (3 to 12) flowered; color of flower darker red than in *L. cardinalis,* more like *L. fulgens;* distinguished from all similar ones by the short lobes of the calyx, and the ovate mucronate lower segments of the corolla.

I insert here the description of a nearly related species from the country below Monterey.

LOBELIA PHYLLOSTACHYA, n. sp.: glabra, caule erecto, folioso; foliis lanceolatis, acuminatis, irregulariter dentatis s. inferioribus subintegris; spica infra foliosa, elongata, densiflora; bracteis serrulatis, inferioribus florem longe superantibus, superioribus pedicello longioribus; calycis glabri laciniis subulatis corollam vix æquantibus s. ea brevioribus; laciniis corollæ superioribus linearibus, inferioribus lanceolato-linearibus, acuminatis.

Swamps between Monterey and Cerralbo; flowers in May. Near *L. Texensis,* Raf., but distinguished by its entire smoothness, by the long (6 to 12 inches), thick and foliaceous spike, and by the shorter segments of the calyx.

[42] LOBELIA PECTINATA, n. sp.: caule erecto, scabriusculo, folioso; foliis, bracteis et lobis calycinis pectinato-dentatis, scabris; foliis inferioribus oblongo-linearibus sessilibus, superioribus e basi lata cordata, decurrente angustatis; racemo elongato densifloro, bracteis florem subæquantibus; calycis tubo turbinato pedicellum æquante, lobis duplo breviore; tubo corollæ brevi, lobis superioribus lanceolatis, inferioribus ovatis, ad medium coalitis; antheris styloque inclusis, 2 inferioribus apice barbatis.

Cosihuiriachi in moist places; flowers in September. Annual (?) 1 to 1½ foot high; leaves about 1 inch long; spike dense 4 to 6 inches long, blue flowers 6 lines long; tube with 3 slits about the middle.

[43] ERIOGONUM ATRORUBENS, n. sp.: perenne, foliis radicalibus petiolatis, lanceolatis, elongatis, villosis; caulis glabri glauci internodiis superne tumidis, clavatis; caule iteratim dichotomo, ad bifurcationes bracteis subulatis pilosis instructas involucrum alarem elongato-pedicellatum gerente; involucris campanulatis 5-dentatis, margine pilosis, multifloris.

Cosihuiriachi on the banks of streamlets, flowers in September. Perennial, 1½ to 2 feet high; leaves all radical, 5 to 6 inches long, 9 lines wide, on shorter petioles; some of the lower joints about 6 lines in diameter, the upper ones much less tumid; pedicels 1 to 3, lowest even 4 inches long; involucrum about 1 line long and wide, always 5-toothed, including 25 to 30 deep red flowers; lobes of perigonium about equal; nut olive-green, acuminate, three-winged. Singularly near *E. inflatum,* Torr. and Frem., perhaps too near to be specifically separated; but apparently distinct by the hairy leaves and bracts, the furcate division of the stem, the large number of flowers in each involucrum, and perhaps their purple color (not mentioned by Torrey).

[44] PHASEOLUS BILOBATUS, n. sp.: caule prostrato, pilis retrorsis hispido; foliolis adpresse pilosis reticulatis, lateralibus subsessilibus inæqualiter bilobatis, terminali petiolulato, lineari-oblongo; pedunculis folia longe superantibus multifloris; calycis hirsuti laciniis subulatis tubum æquantibus; leguminibus compressis, hirsutis, curvatis; seminibus lævibus.

Common about Cosihuiriachi; flowers in September. Resembles *Ph. leiospermus,* T. and Gr., but the brown-red flowers and legumes much smaller; shape of the leaves very characteristic. Legume 9 lines long and 1 line wide; seed very small.

collections are very full. Fortunately, Dr. Gregg accompanied the same expedition, and also made rich collections in that almost unknown region, which we may consider as the southwestern limits of the valley of the Rio Grande.

Before going into detail, I will only remark here, what a reference to the map and sections will more fully present, that the country between Chihuahua and Parras has a general elevation of from 4,000 to 5,000 feet; between Parras and Saltillo it rises from 5,000 to 6,000 feet, and thence it rapidly descends towards the lower Rio Grande.

South of Chihuahua a curious leafless *Euphorbia* was collected, with tuberous roots and leafless stem; nevertheless apparently a near relative of *E. cyathophora*. Here, for the first time, *Berberis trifoliata*, Moric., was met with, which appears to inhabit the whole middle and lower valley of the Rio Grande, as we find it again in this collection from Monterey, and Mr. Lindheimer has sent beautiful specimens from the Guadaloupe, in Texas.

Echinocerei and *Echinocacti* appear in greater abundance. The rediscovery of the beautiful *Echinocereus pectinatus* (*Echinocactus pectinatus*, Scheidw., *E. pectiniferus*, Lem., *Echinopsis pectinata*, Salm, in part) is peculiarly interesting, as it furnishes the means of proving a Texan species, which has been confounded with it, to be entirely distinct. The description of the plant (which died without producing flowers) found in several works, as well as in the latest publication on *Cactaceæ*, before me, of Foerster, Leipzig, 1846, was made, as Prince Salm informed me, from specimens sent from Chihuahua by Mr. Potts. It entirely agrees with my specimen from the same region. But the description in Foerster's work of the flower of a specimen in Cassel, flowering in 1843 (not known from where obtained), shows that to be identical with a Texan species, [110 (26)] common between the Brazos and Nueces rivers, which I have described in Engelmann and Gray's Plantæ Lindheimerianæ (Boston Journal of Natural History, V. p. 247) under the name of *Cereus cæspitosus*, and which should now be named *Echinocereus cæspitosus*. *Echinopsis pectinata*, *β. lævior*, Monv., and *γ. Reichenbachiana*, Salm, are perhaps forms of this Texan plant, which varies considerably in its native country. Dr. Wislizenus has sent me a living specimen and dried flowers of *E. pectinatus*. Unfortunately, the plant met with a similar fate to those sent to England by Mr. Potts, and there is none now in cultivation, if I am correctly informed; but I preserve the dried specimen in my herbarium, and have been enabled to draw up from it the description.[45]

[45] ECHINOCEREUS PECTINATUS mihi (*Echinocactus pectinatus*, Scheidw.; *E. pectiniferus*, Lem.): simplex (an semper?), ovato-cylindricus, 23-costatus; areolis elevatis, linearibus, approximatis, junioribus albo-villosis; aculeis radialibus 16–20 subrecurvis, adpressis, pectinatis, albis, apice roseis, superioribus inferioribusque brevioribus, lateralibus longioribus; centralibus 2–5 brevissimis, uniseriatis; tubo floris pulvillis 60–70 brevi-tomentosis aculeos albos s. apice roseos 12–15 gerentibus stipato; sepalis interioribus 18–20 oblanceolatis; petalis 16–18 oblongis, obtusis, eroso-denticulatis, mucronatis.

Bachimpa, south of Chihuahua; flowers in April. Stem 7 inches high, below 3½, above 2½ inches in diameter; upper and lower spines 2 lines, lateral 4 lines long; central spines mostly 3, sometimes 2, and below as much as 5, in one vertical row, ½ to 1 line in length. Flowers about 3 inches long and wide; red or purple spiny bristles on the tube 2 to 3 lines long, the uppermost 3 to 5 lines long, only 3 to 5 together.

It will not be amiss to introduce here again a more complete and correct description of its Texan relative.

ECHINOCEREUS CÆSPITOSUS mihi (*Echinopsis pectinata*, auctorum partim; *Cereus cæspitosus*, Engelm., l. c.): ovatus, cæspitosus, 13–18-costatus, areolis elevatis, linearibus, approximatis, junioribus albo-villosis; aculeis radialibus 20–30 subrecurvis adpressis, pectinatis, albis (nonnunquam roseis [castaneis], Lindh.) superioribus inferioribusque brevioribus, lateralibus longioribus, centralibus nullis; tubo floris pulvillis 80–100 longe cinereo-villosis setas apice s. totas fuscas s. nigricantes 6–12 gerentibus, stipato; sepalis interioribus 18–25 oblanceolatis integris s. denticulatis; petalis 30–40 obovato-lanceolatis, obtusis, acutis, s. mucronatis, ciliato-denticulatis; stigmate viridi infundibuliformi, 13–18-partito; bacca viridi ovata, perigonio coronata, villosa, setosa, demum nudata; seminibus obovatis tuberculatis, nigris.

From the Brazos to the Nueces, in Texas, Lindheimer; flowers in May and June. Generally 1 to 2 inches high and of nearly the same diameter, rarely as much as 5 or 6 inches high and 2 to 3½ inches in diameter; longer lateral

Near San Pablo another *Echinocereus*[46] was found, and dried flowers as well as [111 (27)]
living specimens have safely arrived here. A large *Echinocactus*[47] was collected near
Pelayo; unfortunately no flowers were seen, but the specimen brought to St. Louis is so far in fine condition. Of another smaller but most elegant species of the same genus,[48] Dr. Wislizenus collected the living plant and flowers, and Dr. Gregg the ripe fruit. It is distinct from
the other *Echinocacti* found in those regions by the membranaceous very thin sepaloid [112 (28)]

spines in different specimens 2 to 4 lines long. Flowers in the northern specimens, from Industry, 2 inches long and wide, in those from New Braunfels 2½ to 3 inches in diameter and length, generally a little wider than long when fully open; brown or black bristles on the tube 2 to 5 or 6 lines long, surrounded by wool, which is often 3 lines in length.

[46] ECHINOCEREUS ENNEACANTHUS, n. sp.: ovato-cylindricus 10-costatus; areolis elevatis, orbiculatis, distantibus, junioribus breviter albo-tomentosis; aculeis angulatis, compressis, rectis, albis; radialibus 8 subæqualibus, centrali singulo longiore, demum deflexo; floris tubo pulvillis 30–35 albo-tomentosis setas spinescentes albidas fuscatasque inferioribus 6, superioribus 2–3 gerentibus stipato; sepalis interioribus 10–13 oblongo-linearibus, petalis 12–14 lineari-oblongis obtusis s. mucronatis, apice denticulatis; stigmatibus supra stamina brevia exsertis, 8–10 linearibus elongatis.

Near San Pablo, south of Chihuahua; flowers in April. Plant 5 to 6 inches high, 3 to 4 in diameter, branching from the base; areolæ about 1 inch distant from one another; spines stout, angular, like those of *E. triglochidiatus*, lateral spines 9 to 16, central one 18 to 22 lines long. Flowers 2½ to 3 inches long, red; spiny bristles in the axils of the lowest sepals (on the ovary), four brown 2 to 4 lines long, and two white 3 to 4 lines long; higher up the number of the brown bristles diminishes, and on the upper part of the tube we find only two white bristles of 6 lines length in the axils.

[47] ECHINOCACTUS FLEXISPINUS, n. sp.: globosus, vertice subnudo, costis 13 obliquis, tuberculato subinterruptis; areolis ovatis, junioribus albo-tomentosis, distantibus; aculeis junioribus rubellis, demum cinereis; radialibus 9–11 rectis s. subflexuosis, superioribus tenuioribus, infimo breviori, curvato, lateralibus longioribus compressis annulatis, rectiusculis; centralibus 4 angulatis compressis annulatis, 3 superioribus rectiusculis s. curvatis, inferiore longissimo flexuoso, plerumque paulo uncinato, deflexo.

Pelayo, between Chihuahua and Parras. The specimen before me is 10 inches high, and the same in diameter; ribs thick but not rounded; areolæ (without the floriferous areolæ, which are 3 to 4 lines long) 6 lines long and 4 wide, 1 or 1½ inch distant; upper spines the most slender, 1¼ to 1½ inch long; lowest one 1 to 1¼ inch long, stouter; lateral spines 1½ to 3 inches in length, slightly and sometimes indistinctly annulated; upper central spines 2½ to 4 inches long; lower spine stoutest, 4 to 5 inches long, mostly deflexed, often flexuous and twisted, more curved or even hooked at the extremity, much compressed, 4-angled, sharply carinate above and below, slightly annulated.

[48] ECHINOCACTUS UNGUISPINUS, n. sp.: depresso-globosus, costis 21 interruptis tuberculatis, areolis approximatis junioribus albo-tomentosis; aculeis radialibus sub-21 tenuioribus, albidis, recurvis, intertextis, centralibus 5 (rarius 6) robustioribus, longioribus, corneis, sursum versis, singulo robustissimo, fusco deorsum flexo; floris ovario tuboque brevi sepalis membranaceis, auriculato-cordatis, fimbriatis stipato; petalis oblongis obtusis; stigmate brevissimo conico 10–15-sulcato (s. partito?).

About Pelayo; flowers in May. A very elegant plant; the specimen before me 4 inches in diameter, 3 inches in height. The large recurved spines — especially the stoutest central one, which is of a bluish horn-color, with a brown point, and is curved and bent downward like a large fang — cover the whole surface of the plant, and give it a very pretty appearance. Lower radiating spines 6 to 10, upper 12 to 15 lines long; upper central spines 12 to 18 lines long, but lower stouter one only 10 to 12 lines in length. Flowers described from the shrivelled specimens found on the living plant, about 1 inch in length, and probably pale red. I have little doubt that some fruits collected in the same region (about San Lorenzo) by Dr. Gregg belong to this species; the fleshy oval berry is 10 or 12 lines long, covered with the same auriculate thin scales which we find on the flowers, and crowned with the remnants of the flower; seeds black, much compressed, somewhat rough, albumen considerable, embryo curved, cotyledons short obtuse. This is a very remarkable plant, and approaches in shape some *Mamillariæ;* the tubercles which form the interrupted ribs are sideways compressed, have a tomentose groove on their upper edge, which ends in a regular axillary depressed areola, like that of a true *Mamillaria*, but the scaly ovary and the curved embryo prove it to be an *Echinocactus.* The specimen brought here by Dr. Wislizenus died soon after it arrived, as many of those collected in April and May during the flowering season, though only two months on the road, while those collected the year before, between August and November, which had been packed up for eight or ten months, mostly do very well now. Dr. Gregg's seeds, however, have germinated well.

scales on the tube of the flower and the juicy glabrous fruit, in which respect it resembles my *E. setispinus* from Texas. *E. Texensis*, Hpfr., has a juicy fruit, covered with woolly and spiny scales; *E. Wislizeni* and others have a dry fruit, covered with hard scales.

My *Opuntia frutescens* (Plant. Lindh., l. c. p. 245), which had been collected by Mr. Lindheimer along the Colorado and Guadaloupe rivers, in Texas, was also found south of Chihuahua by Dr. Wislizenus, and again along the route near Parras, and below Monterey. The suggestion made in the Plant. Lindh., that it may be a southern variety of *O. fragilis* of the Upper Missouri, has proved to be erroneous, as they belong to quite distinct sections of the genus *Opuntia*. *O. frutescens*, together with *O. vaginata* (vide note 18), is one of the *Opuntiæ cylindraceæ gracliores*, and is apparently nearly related to *O. leptocaulis* DC., but is easily distinguished by its strong, white, single spines, while *O. lept.* has three short blackish bristles.

Agave Americana, with several relatives, was found in abundance on this part of the route. *Argemone Mexicana*, white, yellow, or rose-colored, was frequently met with; *Samolus ebracteatus* occurred in moist places so far inland and on such elevations, while before it was only known as a littoral plant; *Malvaceæ*, *Œnotheræ*, *Asclepiadaceæ*, *Gilieæ*, *Solaneæ*, *Justiciæ*, shrubby *Labiatæ*, were collected of many different species. But the great characteristic of the country were the shrubs forming the often impenetrable thickets called "chaparráls." They are mostly spinous, very much branched, often with remarkably small leaves, and not rarely with edible [113 (29)] fruits. Among them many rhamnaceous and celastraceous shrubs, and some *Euphorbiaceæ*, were particularly conspicuous; as well as some *Mimoseæ*, one of which I must not forget to mention, because it is perhaps the smallest shrub in this family, not more than one or two inches high, with diminutive leaflets, but large purple flowers. It was collected near Chihuahua.

One of the most offensive of these chaparrál-shrubs was the *Koberlinia*, Zucc., called here *Junco* (Gregg); a small tree rather than a shrub, about 10 feet high, stem 4 to 6 inches in diameter; wood hard, dark brown with white alburnum; terminal branches green, with a dark brown spinous termination, 1 to 2 inches long, and 1½ to 2 lines in diameter; very small subulate leaves soon deciduous; small white flowers in short lateral racemes; fruit not seen; in flower in May. It was frequently seen from south of Chihuahua to Monterey (and Matamoros, Gregg).

We find here again the interesting *Chilopsis* mentioned above [see note 11], also *Larrea glutinosa* (note 10), and another zygophyllaceous shrub, a true *Guajacum*,[49] which appears to be an undescribed species; it belongs to those plants that connect the Mexican with the Texan flora, as we find it extending from Parras to Monterey, and from there to the Upper Colorado, in Texas. *Tecoma stans* reappeared here with smaller pubescent leaves and more alate petiole, though probably not distinct from the larger and smoother plant found below Paso.

The beautiful *Fouquiera splendens* (see note 16), with its panicles of long tubular crimson flowers, rose here above all other shrubs; in some instances it reached a height of from 20 to 30 feet, and perhaps more, always in single stems.

A few species of *Yucca*, together with *Opuntia arborescens* (note 5), formed almost the only trees on the arid plains. But in the valley of the Nazas occur stately trees of a species of *Algarobia*, distinct from the *A. glandulosa* of the north, with broader legumes, larger seeds, and few or no glands on the leaves.

[49] GUAJACUM ANGUSTIFOLIUM, n. sp.: foliis sub-5 (4–8) jugis glaberrimis, foliolis oblongo-linearibus, reticulatis; pedicellis et basi calycis pubescentibus; ovario bilobo, pubescente; capsula bivalvi, seminibus 2 ovatis.

About Parras; collected also by Dr. Gregg, who has found the plant common from Monclova to Parras, Monterey, and Camargo; found by Mr. Lindheimer on the Pierdenales river in Texas; flowers in April and May. Shrub or small tree with very knotty branches; leaflets mostly in 5 or 6 pairs, only on young vigorous shoots 6 to 8 pairs, mostly only 4 lines long, ½ to 1 line wide, reticulated on both sides. Purple flowers 6 lines in diameter; seeds yellow, of the size of small beans. The hard and heavy yellowish brown wood is called "*Guajacan*" about Saltillo, and used as a sudorific and in venereal diseases (Dr. Gregg).

About Saltillo *Echinocactus Texensis*, Hpfr. (*E. Lindheimeri*, Engelm., in Plant. Lindh. l. c.) was found, which extends from here to Matamoros, and to the Guadaloupe and Colorado, in Texas. The pretty *Mamillaria strobiliformis*[50] grows on rocks near Rinconada. *Hunnemannia fumariæfolia*, Sweet, was collected near Saltillo, with smaller flowers (1½ inch [114 (30)] in diameter), and near Rinconada, with larger ones (3 inches in diameter); an interesting plant, the eastern representative of the Californian *Eschscholtzia*, but perennial, with a small torus, a different stigma, etc.

I cannot omit to introduce here a beautiful shrub discovered on the rocks about Agua Nueva and Buena Vista by Dr. Gregg. Depending upon Don's characters of *Cowania* as correct, I must consider this plant as the type of a new genus, which I have great pleasure to dedicate to its indefatigable discoverer, my friend Dr. Josiah Gregg, whose name has already been frequently mentioned in these pages.[51] *Greggia rupestris* is a lovely, sweet-scented shrub, with flowers resembling roses in shape and color, so that Dr. Gregg was induced to name it the "Cliff rose."

North and northeast of Monterey we reach the lower country, and with it a different vegetation; here is the home of the shrubby *Cassieæ* (*Parkinsonia*, *Casparea*, etc.), and *Mimoseæ*; *Sophora*, *Diospyros*, some species of *Rhus* and *Rhamnus* are common here, as well as a climbing yellow-flowered *Hiræa*, while another erect red-flowered species grows on the table-lands near Parras. One of the most beautiful shrubs of that district is *Leucophyllum Texanum*, Benth., with its whitish tomentose leaves and sweet-scented blue flowers. It is common from San Antonio, in Texas, to Monclova, and from Cerralbo to Camargo, but is not seen on the table-lands.

Vitis bipinnata and *V. incisa*, well known in the southwestern parts of the United [115 (31)] States and Texas, were also found here. Remarkable herbaceous plants were a *Nicotiana*, an *Orobanche* (on the sea-coast), an *Eustoma*, several *Asclepiadaceæ*, *Malvaceæ*, *Cucurbitaceæ*, *Labiatæ*, and others. *Lobelia phyllostachya* has already been mentioned above. (See note 41.)

Hasty and imperfect as this notice of the collections of Dr. Wislizenus is, it cannot but impress the botanist with the richness and novelty of the flora of these countries, and invite the arduous explorer to further exertions.

St. Louis, *December*, 1847.

[50] Mamillaria strobiliformis, n. sp.: simplex ovato-conica, tuberculis imbricato-adpressis, conicis, applanatis, sulcatis; aculeis rectis radialibus, sub-10 albidis, centralibus 3 fusco-atris, 2 minoribus sursum versis, singulo longiore porrecto; floribus in vertice lanato centralibus, ovario lanoso; sepalis sub-10 lanceolatis, acutis, integris; petalis sub-24 ovato-lanceolatis, mucronatis, integris vel versus apicem erosis; stigmatibus 7 flavis erecto-patentibus exsertis.

Rinconada, on rocks; flowers in June. About 3 inches high, and 2 inches in diameter below; tubercles in 10 to 13 oblique rows closely adpressed, so as to give the whole plant the appearance of a pineapple or cone, tomentose in the groove and the axils, about 6 lines long; radial spines 3 to 5, central 5 to 8 lines long; flowers central, 3 to 5 in a cluster together imbedded in long and dense wool, about 15 lines long and wide; petals deep purple.

[51] Greggia, n. gen. (*Greggia*, Gærtn. = *Eugenia*, Mich., fide Endlicher). Calyx tubulosus, 5-lobus, imbricatus; petala 5 calycis fauci inserta; stamina numerosissima cum petalis inserta; ovaria plura fundo calycis inserta 1-, rarius 2-ovulata; stylus villosus, deciduus, stigma nudum; ovulum supra basin ovarii placentæ laterali insertum, anatropum; achenia villosa, ecaudata; semen unicum, erectum, embryo radicula infera.

A Mexican shrub with small cuneate truncate dentate leaves with adnate stipules, and solitary rose-colored or purple sweet-scented flowers.

Greggia rupestris, n. sp. Cliffs about Saltillo, Buena Vista, and Agua Nueva, flowers January to March; several feet high, much branched, leaves about 6 lines long, and at the apex 3 lines wide, crowded; revolute on the margin, glabrous above, tomentose beneath; flowers terminal on short branchlets 15 to 18 lines in diameter. Nearly related to *Cowania*, but distinguished by the imbricate, not valvate calyx, the red, not yellow flowers, and the deciduous, not persistent style.

III.

PAPERS ON CUSCUTINEÆ.

I. A MONOGRAPHY OF THE NORTH AMERICAN CUSCUTINEÆ.

From the American Journal of Science, Vol. XLIII. No. 2, October, 1842.

In directing my attention to the different forms of Cuscuta of this vicinity, I was surprised to find several distinct species, as well as a remarkable allied genus, while only a single species, the *Cuscuta Americana*, is noticed in botanical works. Having been induced to examine particularly as well the species of this neighborhood, as the specimens with which my correspondents in different parts of the country have favored me, I offer the result of my investigations to the public, with the view of directing the attention of botanists throughout our wide-spread country to the subject; trusting that this neglected tribe of plants may thereby be further elucidated. I therefore avail myself of this opportunity to request botanists in different parts of the country to communicate specimens of the Cuscutæ of their vicinity, accompanied by the plant on which they grow.

ORDER CONVOLVULACEÆ, *R. Br.* TRIBE 2. CUSCUTINEÆ, *Link.*

Leaves reduced to scales. Embryo spirally rolled around a mucilaginous albumen, without cotyledons.

This remarkable tribe is appended to *Convolvulaceæ*, and bears to that family the same relation which *Monotropeæ* bear to *Pyrolaceæ*, and *Orobancheæ* to *Antirrhineæ*: these plants, which may be likened to Phanerogamous Fungi, being all destitute of verdure and of proper leaves (bearing scales in place of the latter, but never leafless in the full meaning of the term); while in the structure of their flowers they agree with plants of the highest organization. They are all parasitic on other vegetables; the *Cuscutineæ* on their stems; most *Orobancheæ* on their roots; and the *Monotropeæ* on their mouldering remains: hence they are obviously analogous to the class *Entozoa* of the animal kingdom; and may be termed *Epiphyta*, growing on plants.

The Cuscutineæ are distinguished from other Epiphyta by their growing on and twining around the stems (and occasionally the leaves) of other plants, as well as by their large seeds, resembling those of Convolvulus, but presenting a long and slender embryo, which is spirally coiled around a mass of mucilaginous albumen. *Monotropeæ* and *Orobancheæ* have extremely [334] minute seeds, in some respects similar to the spores of Acotyledonous plants. The seeds of Cuscutineæ germinate in the ground; but soon finding the plants round which they twine (turning constantly to the left, like all Convolvulaceæ), they strike their papillose roots into the epidermis of the stem, from which they subsequently derive their nourishment; their own original stems soon withering away, so that the plant is no longer in direct communication with the earth.

As in the *Entozoa*, the same species inhabits only the same or some nearly related animal, so in the *Epiphyta*, each species is for the most part restricted to the same or similar plants. This is more constantly the case in *Orobancheæ*, where the germinating embryo fixes itself at once upon its favorite plant; but in Cuscuta, where the seed germinates in the ground, and the stem afterwards lays hold of the plant which affords its nourishment, it frequently twines around all the plants in the neighborhood, and is capable of extracting from them its food. Some species, however, are more constant in their predilections than others; as, for example, the European *Cuscuta Epilinum*, which never grows on any other plant than Flax; and our *Lepidanche Compositarum*, which is confined to *Solidago*, *Helianthus*, and some other *Compositæ*. Yet several, like the European *Cuscuta Epithymum* and the American *C. Polygonorum*, live promiscuously on most plants within their reach, evidently preferring, however, some particular species or genus, and seldom found except in its immediate vicinity. I have therefore ventured, as far as practicable, to name the species of Cuscuta after the plant upon which they grow; in accordance with the nomenclature frequently adopted of late in the case of parasites, especially in the genus *Orobanche* (Examp. *Orobanche Galii, O. Eryngii, O. Scabiosæ, O. Salviæ*, etc.) — thereby designating an important circumstance in the history of the plant.

Before I proceed to describe the North American species known to me, it may be well to present a general

Conspectus of the species that have come under my observation.

I. CUSCUTA, *L.* Sepals united into a 4–5-cleft calyx.

§ 1. *Styles united into one.*

1. C. MONOGYNA, *Vahl.* — Eastern Europe.

§ 2. *Styles two.*

* *Stigmas filiform. — European.* [335]

† *Flowers generally pentamerous.*

2. C. EPITHYMUM, *L.* Segments of the calyx and corolla acuminate. — Europe.
3. C. EPILINUM, *Weihe.* Flower globose: segments of the calyx and corolla orbicular, abruptly acuminate. — Europe.
4. C. PLANIFLORA, *Tenore.* Flower campanulate, open. — Italy.

†† *Flowers generally tetramerous.*

5. C. EUROPÆA, *L.* Lobes of the calyx and corolla obtuse. — Europe.

* * *Stigmas capitate. — American.*

A. Corolla cylindric, its remains covering the ripening capsule.

† *Flowers generally pentamerous.*

6. C. CHILENSIS, *Ker.* Corolla much longer than the campanulate calyx: anthers sessile. — Chili.

†† *Flowers generally tetramerous.*

7. C. CEPHALANTHI. Lobes of the calyx and corolla obtuse: anthers with filaments. — St. Louis.
8. C. CORYLI. Lobes of the calyx and corolla acute. — St. Louis.

B. Corolla campanulate, its remains persistent at the base of the ripening capsule.

† *Flowers generally pentamerous.*

9. C. VULGIVAGA. Carinate lobes of the calyx and the lobes of the corolla obtuse. — Vermont to Georgia and Missouri.
10. C. SAURURI. Smooth, lobes of the calyx and corolla obtuse. — Western New York to Missouri.
11. C. PENTAGONA. Lobes of the 5-angled calyx smooth, roundish; those of the corolla acuminate. — Virginia.
12. C. VERRUCOSA. Lobes of the campanulate calyx verrucose, roundish; those of the corolla acuminate. — Texas.

†† *Flowers generally tetramerous.*

13. C. POLYGONORUM. Lobes of the calyx and corolla acute. — St. Louis.

II. LEPIDANCHE. Calyx consisting of 10–15 imbricated sepals.

1. L. COMPOSITARUM. Western United States.

(1.) CUSCUTA, *L.* (DODDER.)

Calyx monosepalous, 4–5-cleft, persistent. Corolla campanulate or urceolate, 4–5-cleft. Styles one or two. Capsule 2-celled, 4-seeded.

Twining parasitic plants, bearing the general character of the family. The stem is filiform, simple or generally branched, of a whitish, yellowish, or orange color, with scaly leaves. The inflorescence is a cyme (with a central flower opening first, and axillary or lateral flowers, which open afterwards), with whitish sessile or pedunculate flowers, more or less clustered (conglomerate) in some, and rather loose (commonly called paniculate) in other species. Some bracts are observable on the peduncles and pedicels, but they are always easily distinguished from the calyx.

The first or central flowers of the inflorescence are mostly 5-parted, but the lateral or secondary ones are in some species regularly 4-parted, in others nearly always 5-parted. The calyx is constantly monosepalous, [336] deeply and somewhat irregularly 4- to 5-parted, and persistent.

The corolla is cylindric, urceolate, or campanulate, with the limb erect, spreading or reflexed, and together with the stamina either persistent at the base of the capsule, or more frequently separated from its insertion and covering its summit. Its texture is in some species nearly membranaceous, in others thicker and more fleshy.

The stamina are united with the tube of the corolla up to the base of the segments. Near their base, within the tube of the corolla, they bear a scale, which is evidently not a distinct organ, but only an appendage of the stamina. They are present in all the species which I have examined; sometimes consisting only of one or few teeth on both sides of the filament (as in C. Coryli), but commonly forming a distinct lamina. In some they are bifid, in others undivided; but in all either crenulate or fimbriate, or laciniately or pinnatifidly divided. They are erect and appressed to the tube in several species; while in others they are convergent, closing the tube and including the ovary.

The ovary is always 2-celled, 4-ovulate; the styles two (in a single species united into one), frequently unequal in length; in a few cases supported by a stylopodium. The stigma is either filiform, as in the European, or capitate, as in the American species.

The capsule is globose or depressed, crowned by the persistent styles and stylopodium (when the latter is present); it is 2-celled, and sometimes 4-seeded; but more generally by abortion, 3-, 2-, and even 1-seeded. In the European species, it separates by circumscission from its base, leaving the dissepiment persistent on the calyx. In the American, the capsule does not appear to open regularly, but it separates easily from the calyx when ripe.

I have seen very few abnormal irregularities in the flowers of Cuscuta. Sometimes one or more segments of the corolla are partially or entirely changed into a stamen, and the capsule is occasionally 3–4-carpellary, instead of 2-carpellary.

1. Cuscuta Cephalanthi, n. sp.: stem high, branching; flowers somewhat pedunculate, mostly 5-parted; tube of the corolla cylindric (after flowering ventricose), twice the length of the obtuse spreading segments, and of the ovate obtuse lobes of the calyx; stamens shorter than the limb; the scales ovate, laciniate, nearly appressed; [337] styles equal to the depressed ovary; capsule depressed, covered by the remains of the corolla.

On Cephalanthus; also on Vernonia, Aster, Bœhmeria, and other plants (especially Compositæ), on the margin of ponds and swamps near St. Louis, where it is the most common species. I have observed it since 1833; but have only met with it in the immediate vicinity of Cephalanthus. July to September.

The whole plant is whitish or pale yellow; the stem high and much branched; the flowers sometimes clustered and nearly sessile, but generally more or less pedunculate, and disposed in compact or rather loose cymes. The divisions of the calyx are very unequal, ovate, or roundish, obtuse, rarely with a little point, covering only the lower half of the tube. The tube itself is perfectly cylindrical in the young flower; but afterwards swells by the enlargement of the ovary, and becomes somewhat urceolate. The lobes of the corolla are ovate, obtuse, somewhat auricled at the base, and campanulate or spreading, half as long as the tube, but longer than the stamina. The corolla is membranaceous, not fleshy. The flowers are mostly 5-parted; but the latest ones of the season are often 4-parted, or even 3-parted. The ripe capsule separates easily from the calyx, apparently without bursting.

2. Cuscuta Coryli, n. sp.: stem branching; flowers peduncled, subumbellate, mostly 4-parted; tube of the corolla cylindric, equal in length to the ovate acutish crenulate inflexed lobes, and the acute carinate segments of the calyx; stamens a little shorter than the limb; the scales appressed, bifid, consisting of few teeth; styles as long as the ovary with the stylopodium; capsule depressed, covered with the remains of the corolla, crowned by the stylopodium and the reflexed styles. Var. β. stylosa: styles much longer than the ovary, exserted.

On Corylus, in the barrens west of St. Louis, in August and September. β. On Solidago, in dry prairies near St. Louis.

This species is nearly related to the foregoing, but may be easily distinguished by the shape and proportions of the calyx and corolla, and by the stylopodium on the ovary. The corolla is fleshy, not membranaceous, [338] and finely crenulate; the lobes always erect and somewhat incurved. The scales of the filaments are smaller than in any other of our Cuscutæ, and consist of one or two teeth on each side of the filament (where it adheres to the tube), thereby indicating the true nature of these singular "nectaria." It appears to be rarer than the other species, and grows more on dry ground.

3. Cuscuta vulgivaga, n. sp.: stem branched; flowers pedunculate, somewhat glomerate or more lax, generally 5-parted; tube of the corolla deeply campanulate, longer than the pellucid-punctate open (finally reflexed) lobes, and the roundish, carinate, obtuse and slightly crenulate segments of the calyx: scales convergent, fimbriate, united at the base; styles about as long as the ovary (with the stylopodium); the remains of the corolla persistent at the base of the sub-globose capsule.

Var. *α.* LAXIFLORA: flowers in loose cymes. *β.* GLOMERATA: flowers conglomerate. *γ.* TETRAMERA: flowers in umbelliform cymes, 3–4-parted.

This species has apparently not only the widest range of all the American Cuscutæ, but is less restricted to the same genus or family of plants. Indeed I have scarcely met with it twice upon the same species. Var. *α.* is the southern and western form: Western New York on Decodon, *Dr. A. Gray;* Missouri on Cephalanthus and Amphicarpæa, and Georgia, on —— ?, *J. Carey;* Alabama, on Salix and Aster, *S. B. Buckley.* Var. *β.* is the northern form: my specimens are from Vermont, on Leersia, and New Hampshire, on Solidago, both from *Mr. J. Carey.* Var. *γ.* Connecticut, on Urtica, *J. Carey.*

The *Cuscuta vulgivaga*, is perhaps in part the Cuscuta Americana of Linnæus, and of many later botanists. But their diagnoses are too incomplete to decide the point, and different species undoubtedly have been confounded under this name. Even Linnæus himself (Spec. Plant. ed. 1, p. 124), referring to Gronov. Virg. and to Sloane, Hist. I., p. 201, t. 128, f. 4, confounds two distinct species. Which of them is to be the *C. Americana?* Linnæus has only the following words: "Cuscuta floribus pedunculatis." Michaux, (I., 175): "Cuscuta, floribus pedicellatis, pentandris." Pursh (I., 116): "C. fl. pedunculatis umbellatis 5-fidis." Other botanists add, "stigmatibus capitatis." [339] Nuttall, gen. (II., addit.) on the other hand has it: "flowers mostly pentandrous and sessile;" and Sprengel (Syst. Veg. I., 864) brings his C. Americana under the section with glomerate subsessile flowers. While these authors refer to one or more North American species, others apply the name with at least equal justice to a West Indian plant. Linnæus himself cites Sloane, Hist. I., t. 128, f. 4. After him Jacquin (Stirp. Am. p. 24), Swartz (Obs. p. 54), and others describe a West Indian species. The name may therefore properly be reserved for Sloane's plant, or may be discarded altogether. The only reason I have in supposing that most North American authors give it to *Cuscuta vulgivaga*, is that this is the most common and the widest spread species in the United States, and has generally the flowers longer-peduncled than any other.

This Cuscuta is intermediate between C. Cephalanthi and C. Saururi. In all three the lobes of the calyx and corolla are obtuse, and the former shorter than the tube of the corolla. But our plant is distinguished from both by the carina of the lobes of the calyx, which is formed by larger uneven prominent cells, and by the large pellucid dots in the substance of the corolla, which may be mistaken for glands, but are nothing but cells larger than the rest of the tissue. The carinæ of the calyx are most prominent on the three outer lobes, and sometimes hardly perceptible on the two inner; but even then the large irregular cells are easily distinguished by the lens. The lobes of the corolla are shorter than the tube, as in C. Cephalanthi: the scales are large and incurved, and the corolla remains at the base of the capsule, as in C. Saururi. The tube is campanulate, but deeper than in C. Saururi or C. Polygonorum. The flowers and fruit are larger than in Cephalanthi, and (especially in var. *α.*) nearly of the same size as in C. Saururi. The styles are in some specimens a little longer, in others a little shorter than the ovary, which appears to be crowned by a stylopodium: this however it is hardly possible to ascertain satisfactorily in the dried specimens.

4. CUSCUTA SAURURI, n. sp.: stem low, branching; flowers 5-parted, somewhat pedunculate, at length in spikes; tube of the corolla campanulate, equal to the obtusish campanulate or spreading lobes, and longer than the obtuse segments of the calyx; stamens as long as the limb; the scales pinnatifid-laciniate, convergent, covering [340] the ovary; styles as long as the ovate-globose ovary with the stylopodium; remains of the corolla persistent at the base of the subglobose capsule.

Margin of lakes and swamps, in the "American Bottom" opposite St. Louis, on Saururus, where it was discovered in September, 1841, by my friend, Ch. Geyer, the indefatigable botanist who has signalized himself in the Northwestern Expedition of Mr. J. N. Nicollet in 1839. Alabama, *Dr. A. Prout.* Texas, on Bœhmeria, Polygonum, &c., *F. Lindheimer.* A variety with rather larger calyx-lobes, in other respects perfectly agreeing with the above description, was obtained by Dr. A. Gray, in Western New York (also on Saururus?).

This species bears a great resemblance to C. Polygonorum; but differs from it in the much stouter stems, the greater size of the flowers, the larger convergent scales, and the stylopodium on the ovary. The stems are one-third of a line or more in diameter, and are stouter than in any other of our species. It is the latest species in blossom, the flowers not appearing before the beginning or middle of September; while C. Polygonorum commences in August, and C. Cephalanthi and C. Coryli, which are the earliest flowering species of our neighborhood, are in bloom by the end of July.

5. CUSCUTA PENTAGONA, n. sp.: stem branched; flowers pedunculate, subumbellate, small, 5-parted; tube of the corolla open-campanulate, shorter than the long acuminate lobes, and the smooth, roundish, obtuse lobes of the 5-angled calyx; stamens shorter than the limb; the scales ovate, fimbriate, convergent; styles filiform; about equal to the globose ovary; capsule ——.

On Euphorbia or Tragia, Norfolk, Virginia, *Mr. Rugel;* communicated by Dr. Gray. Also near Houston, Texas, on different low herbs in a wet prairie; flowering in April, *F. Lindheimer.* Beardstown, Illinois, in sandy soil, *Ch. Geyer.*

This species bears some resemblance to the C. Polygonorum, to which it is related by the campanulate flower and the acute lobes of the corolla; but is easily distinguished by the small size of the flowers, the 5-angled calyx whose lobes are not triangular, but roundish and obtuse. The angles are formed by the margins of the [341] lobes of the calyx and correspond with the petals, while in C. Coryli the five angles formed by the five prominent midribs alternate with the lobes of the corolla.

6. CUSCUTA VERRUCOSA, n. sp.: stem low, branching; cymes loose, few-flowered; flowers (small) long-peduncled, 5-parted; tube of the corolla campanulate, shorter than the lanceolate acuminate lobes, and nearly equal to the ovate subacute segments of the verrucose or somewhat hispid calyx; scales ovate, fimbriate, equalling the tube; styles as long as the ovary; capsule globose, surrounded at the base by the persistent corolla.

Var. *α.* HISPIDULA: inflorescence, and frequently also the branches, hispid or glandular-pilose; lobes of the calyx acute, shorter than the tube of the corolla.

β. GLABRIOR: cymes more or less glabrous; lobes of the calyx broader, somewhat obtuse, nearly as long as the tube of the corolla.

Texas: var. *α.* in dry sterile prairies, west of Houston, on Euthamia, Schrankia, Aster, Ambrosia, Evolvulus, and other low herbs; flowering in April and May, *F. Lindheimer.* *β.* with the preceding variety, *F. Lindheimer:* on Petalostemon, *Drummond* (3d collection, No. 247).

This species is the lowest of all the American Cuscutæ, and has, together with the foregoing, the smallest flowers. It grows on open prairies, in dry soil. In all these respects, therefore, it takes in Texas the place of *Cuscuta Epithymum* in Europe. Like that species, it is not restricted to a few plants, but appears to creep over everything in its way. It is the only Cuscuta known to me with any appearance of pubescence.

Stem from 4 to 6 inches high, smooth (*β.*) or more or less hispidly pubescent with pellucid vesicular hairs, (*α.*) especially in the inflorescence; peduncles filiform, many times longer than the flowers; calyx always rough, but the vesicles less hair-like, more glandular, or when dry like warts. In flowering, the calyx is campanulate, or even somewhat turbinate, but soon after assumes a hemispherical shape, which is the one figured in the plate. Lobes of the corolla very acute, spreading, white; after flowering the tips incurved, turning brown. Stigmas globose, purplish-brown.

This Texan species is nearly related to C. pentagona: the size of the flowers, shape of corolla and the [342] scales, are the same; but it is easily distinguished by the loose and few-flowered cyme, and by the tuberculate or hispid campanulate (not pentagonous, smooth, and membranaceous) calyx.

7. CUSCUTA POLYGONORUM, n. sp.: stem low, branching; flowers subsessile, glomerate, mostly 4-parted; tube of the corolla campanulate, nearly equal to the acute campanulate or spreading lobes and the acutish segments of the calyx; stamens as long as the limb; the scales mostly bifid, laciniate, appressed; styles as long as the depressed ovary; remains of the corolla persistent at the base of the depressed capsule.

On different species of Polygonum, also on Lycopus, Penthorum, and other plants in the neighborhood; August and September.

This is a much lower plant than C. Saururi, etc., with orange-colored stems, twining round the Polygona in overflowed places, the bottoms of sink-holes, or margins of ponds, west of St. Louis, where in the year 1839 my friend F. Lindheimer — now in Texas, to whose zeal and kindness I owe many specimens from that interesting country — first discovered it. In the following year I found it on the banks of Illinois River, near Peru, in thickets formed by immense Ambrosiæ, with Bidens, Spartina, etc. Whether any Polygonum was there I cannot recollect, having at the time paid no particular attention to this point. The flowers of the specimens from Peru are a little more peduncled, and the very acute segments of the calyx rather longer than the tube of the corolla; but I observe no other difference.

This and C. Saururi are easily distinguished from the others by their orange-colored stems, their larger open campanulate flowers, with the remains of the corolla always at the base of the capsule. The scales of the filaments in C. Polygonorum are intermediate between C. Coryli and C. Cephalanthi in shape, but are more laciniate than in the former. They are appressed to the corolla, so that the large depressed ovary appears naked in the open tube, while in C. Saururi it is covered by the convergent or inflexed multifid scales.

NOTE. — Since the manuscript of this article has been communicated to the American Journal, my attention has been directed to one or two species of Cuscuta indicated by the late Mr. Beyrich, and mentioned by Sir William Hooker in his [343] excellent *Flora Boreali-Americana* (Vol. II. p. 77), and in the first volume of the *Companion to the Botanical Magazine.*

C. umbrosa of Beyrich, in herb. Hook. (Fl. Bor.-Am., l. c.), from Canada, the Northwest Coast, as well as the United States, I am unable to determine from the characters given. It may be either my C. Saururi, or C. vulgivaga, *β.* glomerata: the length of the styles does not appear to afford constant characters in this genus.

C. arvensis of Beyrich, in herb. Hook. (C. Americana? *Hook. Fl. Bor.-Am.*, l. c.), is perhaps my C. vulgivaga, *α.* laxiflora. According to Hooker, Douglas collected it in Oregon.

C. coronata of Beyrich, in herb. Hook., is enumerated but not characterized in *Hook. Compan. to Bot. Mag.*, I. p. 173 (New Orleans, Drummond, 1833), on the stems of Laurus Carolinensis.

C. Epilinum, Weihe, has been introduced, with flax, into some parts of this country, especially Chester County, Pennsylvania; *fide Darlington, Flora Cestrica*, ed. 2.

(2.) LEPIDANCHE,[1] *N. Gen.*

Calyx consisting of many imbricated scales, persistent; corolla tubular, 5-cleft; styles two; capsule 2-celled, 2-seeded.

Very similar to Cuscuta when young, but different in appearance when in flower or fruit. The stem which connects the different clusters of flowers having then disappeared, the latter only remain, consisting of innumerable crowded sessile flowers and scarious scales, spirally and most tightly coiled (with one or several turns) around the stems of the supporting plant, which at a distance appears as if a rope were twisted round it. The flowers are so crowded that many are abortive, and as it were strangled, presenting nothing but a bunch of scales, and others, which are apparently perfect, do not mature seed.

The principal difference between this genus and Cuscuta consists in the calyx, which is not monosepalous, but is composed of numerous imbricated scales; of which the two or five exterior, being much smaller, may be considered as bracts; while the ten inner, which are nearly equal in size and shape, crenulate, and with reflexed or squarrose summits appear to constitute the proper calyx. The corolla and stamens, with their scales, are entirely similar to the corresponding organs in Cuscuta: so is the ovary; but the unequal styles are generally longer in proportion, and the stylopodium is as large as the ovary proper, or even larger. The ovary is 2-celled and 4-ovulate; [344] but I have never seen more than two seeds, separated by the incomplete dissepiment; and frequently only a single seed ripens.

1. LEPIDANCHE COMPOSITARUM: stem low, branching; flowers closely sessile, conglomerate, 5-parted; tube of the corolla nearly cylindrical, longer than the squarrose imbricated calyx, which consists of ten to fifteen scales, twice as long as the oblong obtuse spreading or reflexed lobes of the corolla; stamens equal to the limb, exserted; scales pinnatifidly laciniate, convergent, covering the ovary; styles twice as long as the ovary with the stylopodium; capsule globose, enveloped by the scales of the calyx, crowned by the stylopodium and styles, and covered by the remains of the corolla.

Var. *α.* SOLIDAGINIS: flowers smaller; lobes of the limb reflexed; stylopodium half as large as the ovary.

Var. *β.* HELIANTHI: flowers larger; lobes of the limb spreading; scales of the filaments united with one another forming a 5-lobed crown in the tube; stylopodium larger than the ovary.

This singular plant appears to be peculiar to the Western prairies. I have observed it since 1833 in wet prairies around St. Louis,[2] on Solidago (also on Vernonia, *Ch. Geyer*), and Dr. Clapp has found it on Silphium at New Albany, Indiana; the second variety I have gathered on Helianthus since 1838 in similar localities; flowering in August and September. These varieties may prove distinct species, but for the present I am unable to distinguish them by more important characters than those given above.

The flowers are always 5-parted; the tube is not exactly cylindrical, but a little wider at the mouth than at the base, rather obconic. The styles are longer than in any of our Cuscutæ, and almost always unequal; they are inserted on a distinct stylopodium, which is larger than in any Cuscuta. The stigma is capitate, as in all American Cuscutæ.

EXPLANATION OF PLATE VI. [Reproduced on p. 65.]

Figs. 1–6. CUSCUTA CEPHALANTHI. 1. A tetramerous; 2, a pentamerous flower. 3. Corolla laid open. 4. The ovary. 5. Vertical section of a half-grown capsule. 6. Capsule invested by the remains of the corolla.

Figs. 7–11. C. CORYLI. 7. A flower. 8. Corolla laid open. 9. Ovary and styles. 10. Same of var. *β.* 11. Capsule invested by the remains of the corolla.

Figs. 12–16. C. VULGIVAGA. 12–14. Flowers. 15. Corolla laid open. 16. Ovary.

Figs. 17–21. C. SAURURI. 17. The flower. 18. Corolla laid open, with the inflexed scales. 19. Ovary. 20. Vertical section of the half-grown capsule. 21. Mature capsule.

Figs. 22–24. C. PENTAGONA. 22. Flower. 23. Corolla laid open. 24. Ovary.

Fig. 25. C. VERRUCOSA. Flower.

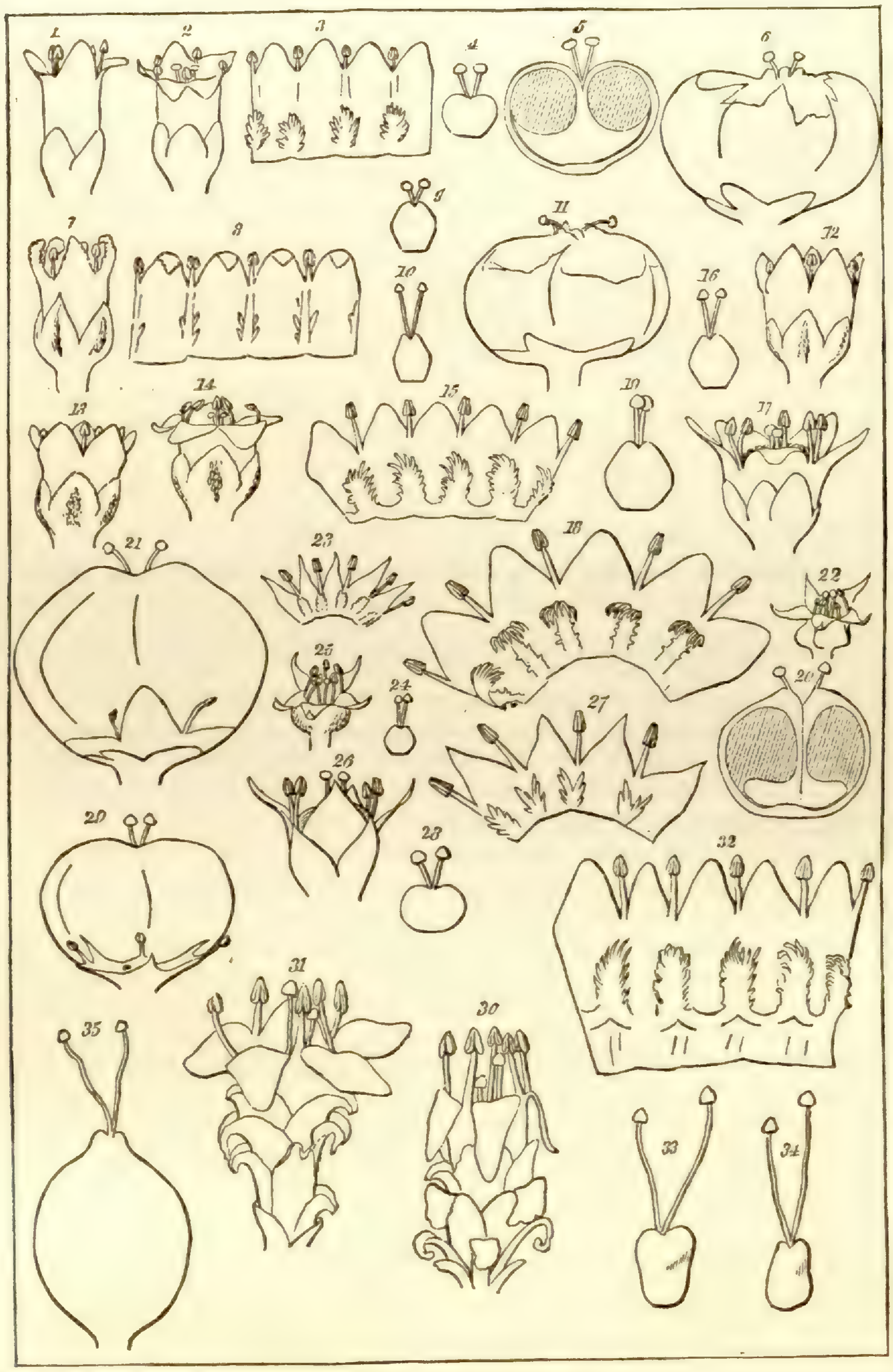
Figs. 26–29. C. POLYGONORUM. 26. Flower. 27. Corolla laid open. 28. Ovary. 29. Capsule.

Figs. 30–35. LEPIDANCHE COMPOSITARUM. 30. Flower of var. *α.* 31. Flower of var. *β.* 32. Corolla of *β.* laid open. 33. Ovary and styles of var. *α.* 34. Same of *β.* 35. Capsule.

N. B. The flower represented in fig. 1 is a line in length; all the others are enlarged in the same proportion.

[1] From λεπίς, *a scale*, and ἄγχειν, *to strangle*: a scaly plant, strangling those on which it grows.

[2] This is manifestly the *Cuscuta Americana* (from St. Louis) of Hooker's account of Drummond's collections, in the *Companion to the Botanical Magazine*, I. p. 173; of which it is remarked that "some of the specimens seem to have all the flowers abortive and turned into scales, which are excessively crowded, and form a dense wreath of a pale straw-color around the branch of some shrub."



DETAILS OF CUSCUTINEÆ.

II. CORRECTIONS AND ADDITIONS TO THE MONOGRAPHY OF CUSCUTINEÆ, IN VOL. XLIII. OF THIS JOURNAL.*

From the American Journal of Science, Vol. XLV. No. 1, July, 1843.

A careful re-examination of this tribe during the past season, as well as the increased opportunity of examining specimens from different parts of North America, have discovered some errors, and made some corrections and additions necessary, which I should indeed prefer to withhold for the present, and subject to the test of another season's study, if it were not important to correct such errors as soon as possible. A fuller description of the new species, with figures, I defer to another time.

I am now convinced, that, although many Cuscutæ prefer some plants to others, yet there is no constancy in this respect, but the same species often grows upon a great variety of widely different plants. I did wrong, therefore, to name them from the genera upon which they grew; and I should much prefer to see the names of *C. Cephalanthi* changed into *C. tenuiflora*, *C. Coryli* into *C. incurva*, *C. Saururi* into *C. umbrosa*, Beyr.? *C. Polygonorum* into *C. chlorocarpa*, and *Lepidanche Compositarum* into *L. squarrosa*, if they had not yet been published.

I. CUSCUTA, *L.*

1. Cuscuta Cephalanthi. — Mostly 4-parted; frequently only 3-parted.

2. Cuscuta Coryli. — Found in many places near St. Louis, on Hazel, Willow, Desmodium, Teucrium, Solidago, etc. The *long* styles observed in some *dried* specimens of this as well as other species, are the consequence of a continued vegetation in the plant-press! The variety β. must therefore be stricken out. Flowers frequently 5-parted.

3. Cuscuta vulgivaga. — Certainly the most common species. The stylopodium is very remarkable in the living specimens which I have examined; and the capsule is oval, even a little pointed, less globose than in any other of our Cuscutæ; but I am not prepared to say that this is the case with all varieties of this very variable [74] species. The stamens and pistils are as long, or rather a little shorter than the corolla, but the latter are elongated after flowering. (*Cuscuta Americana*, Hooker?)

4. Cuscuta Saururi. — It is very probable that *Cuscuta umbrosa*, Beyrich, ex Hooker, is the same; which name must therefore be substituted for mine, though not quite appropriate. This plant is very nearly related to the former species, but can always be distinguished by the more open, campanulate corolla, which in *C. vulgivaga* is globose campanulate, the thinner texture of calyx and corolla, which is destitute of the pellucid dots, and the oblong lobes of calyx and corolla, which are always more or less orbicular in *C. vulgivaga*. Large, overgrown specimens of *C. vulgivaga* have sometimes the lobes of calyx and corolla as long as the tube, but can always be recognized by the above characteristics. Such specimens are those from Alabama and Texas, mentioned in this Journal, Vol. xliii. p. 340. The true *C. Saururi* I have only received from western New York, and from this neighborhood; where it grows in abundance on Polygonum, Saururus, etc. in a few localities.

I must mention here two specimens of a Cuscuta received from Mr. M. A. Curtis, collected, one in Massachusetts, the other in North Carolina. In their principal characters they agree with *C. Saururi*, but the flowers are much smaller and frequently 4-parted; the linear-oblong, obtuse lobes of calyx and corolla are rather longer than the tube; the filaments subulate, shorter than the limb; ovary with a stylopodium; styles short and thick; capsule?

An examination of more complete specimens and the living plants must show whether there is a constant difference between this eastern plant and the western *C. Saururi*. But I may here remark, that the eastern form of *C. vulgivaga* is also much smaller than our western form, and from Connecticut I have also received a tetramerous *C. vulgivaga*!

5. Cuscuta verrucosa. — Under this name I have confounded two Texan species: the description is chiefly taken from the following species, but the figure refers to this one, which was first collected by Drummond and afterwards by Mr. Lindheimer, both times on *Petalostemon multiflorum*. The description must be altered: — C. verrucosa:

* The characters of the new species, etc., here described, have been published in the *London Journal of Botany* for April, 1843, as an appendix to the original monograph, there reproduced. See also a French translation of the first paper, by F. Schultz, in *Archives de Flore*, 1855, I., pp. 65–79. — Eds.

cymes umbelliform, compound ; flowers peduncled (small), 5-parted ; calyx campanulate, verrucose ; segments ovate, somewhat obtuse, shorter than the globose-campanulate tube of the corolla ; lobes of the corolla long- [75]
acuminate, somewhat longer than the tube ; stamens half as long as the limb ; scales ovate fimbriate, rather larger than the tube ; ovary globose, depressed, without stylopodium; capsule depressed. — The tissue of the corolla is composed of large irregular cells.

6. Cuscuta hispidula, n. sp.: stem low ; cymes loose, few-flowered, hairy or nearly smooth ; flowers very long peduncled (small), 5-parted ; tube of the corolla turbinate-campanulate, twice the length of the ovate subacute segments of the calyx, shorter than the long-acuminate somewhat crenulate spreading lobes ; stamens half as long as the limb ; scales ovate, fimbriate, nearly equalling the tube ; ovary with a stylopodium and short styles.

Texas, in dry and sterile prairies west of Houston. Flowering in April and May. Compare the remarks made in Vol. XLIII. p. 341, under *C. verrucosa.*

7. Cuscuta neuropetala, n. sp. : cymes umbelliform, smooth, flowers pedunculate (large), 5-parted ; tube of the corolla campanulate, nearly equal in length to the ovate-lanceolate acute carinate segments of the calyx, and the ovate short-acuminate one-nerved crenulate spreading lobes ; stamens rather shorter than the limb ; scales ovate, fimbriate, incurved, as long as the tube ; styles rather longer than the ovary with the stylopodium.

Texas, in wet prairies near Houston ; on different Compositæ, such as Liatris, Solidago, Helianthus, Rudbeckia, and on Myrica cerifera ; flowering in August ; *F. Lindheimer.*

Flowers rather large, but variable in size ; segments of calyx always very acute, ovate or ovate-lanceolate, somewhat shorter or a little longer than the tube of the corolla. Anthers yellow or purple ; stigmas purple.

This and the last species resemble in the structure of the corolla the more northern *C. Coryli ;* they have the same crenulated margin, the same fleshy-cellular texture, similar incurved tips of the acute lobes, and the same white color, which is not altered in well-dried specimens.

C. neuropetala is distinguished from *C. hispidula* by its perfect smoothness, its flowers being twice or three times as large, its more compact, umbelliform cymes ; the whole plant is taller (in my specimens twelve to eighteen inches high). The calyx segments, at least the three outer ones, are carinate ; the lobes of the corolla are [76]
broader, shorter, composed of small linear cells, which are contracted in the middle into a distinct nerve. Stylopodium large in proportion to the ovary. Capsule not seen. The purple anthers and stigmas in the white flowers, give this species a very pretty appearance.

8. Cuscuta pentagona. — Capsule globose, somewhat depressed, without a stylopodium. The description is taken from the Virginia plant ; the forms from Illinois and Texas constitute two distinct varieties.

β. microcalyx : flowers shorter peduncled ; calyx not remarkably 5-angled, much shorter than the tube of the corolla. — Illinois.

γ. calycina : flowers shorter peduncled ; calyx not remarkably 5-angled, longer than the tube of the corolla, which is equal to the acute lobes. — Texas.

This species bears some resemblance to *C. Polygonorum* on one side, and to the three foregoing species on the other; to these by the acuminate lobes of the corolla, to the first by the depressed ovary and pale greenish-yellow capsule ;[1] but it is distinguished from both by the orbicular lobes of the generally large and more or less pentagonal calyx. The inflorescence represents little umbels in α. or approaches the glomerules of *C. Polygonorum* in β. and γ. The lobes of the corolla are acute, resembling in shape those of the following species, in the Texan variety ; or longer and finely acuminate (similar to *C. verrucosa* and *C. hispidula*), in the more northern forms. Stamens short, only half the length of the limb; anthers nearly globose. Scales large, ovate, fimbriate, sometimes exceeding the tube. Ovary and capsule depressed.

This is probably the earliest species in North America ; in Texas it has been found in bloom in April and May, and near Bardstown early in July ; while here, one hundred miles further south, hardly any other species begins to open its flowers before the last days of that month.

9. Cuscuta Polygonorum. — Segments of calyx generally as long as the tube of the corolla, mostly subacute, but occasionally also somewhat obtuse ; the corolla is thin, membranaceous, composed of a very fine cellular tissue ; stamens broad at base, subulate ; scales smaller than any other species, except *C. Coryli.*

II. LEPIDANCHE.

Last autumn I discovered a second species of this genus, which imposes the necessity of altering the generic character. It must now read : Capsule 2-celled, 1–4-seeded.

The *facies* of the genus refers principally to the first species ; the second has more the appearance of a Cuscuta, but the flowers are also closely sessile.

[1] In all other species which are here mentioned, it is of a brown color, except perhaps in *C. Cephalanthi*, where it is also light-colored.

1. Lepidanche Compositarum. — Stems before flowering orange-colored, soon decaying. (*Cuscuta glomerata*, Choisy, Mem. Soc. Nat. Hist. Genev., ex adnot. A. Gray.)

2. Lepidanche adpressa, n. sp.: flowers sessile, glomerate, 5-parted; calycine scales 7 to 9, imbricated, appressed, ovate or orbiculate, slightly crenulate, the outer ones the largest; tube of the corolla cylindric, a little longer than the calyx, twice as long as the oblong obtuse spreading lobes; stamens shorter than the limb; scales laciniately pinnatifid, convergent, covering the ovary; ovary with the stylopodium equalling the styles; capsule globose, shortly acuminate, covered by the marcescent corolla; 2–4-seeded. (*Cuscuta compacta*, Choisy, l. c., ex adnot. A. Gray. *C. coronata*, Beyr. ap. Hook. ?)

I discovered this species last autumn in the fertile shady woods on the banks of the Mississippi, amongst a most luxuriant growth of vines and underbrush, on Bignonia radicans, Rhus toxicodendron, Laurus Benzoin, Vitis, Cornus, etc. Choisy describes it from specimens collected in Alabama.

The flowers are closely sessile, but distinct, and not in such dense clusters as in *L. compositarum*. The glomerules either form a continuous line round the stem of the parent plant, or they are separate, consisting of from five to ten or more greenish-white flowers. The filiform stout stems are whitish, and do not entirely disappear at the flowering time. The capsules are generally 2-seeded; but as they are not so crowded as in the other species, they are also found 3–4-seeded.

Plate VI. Vol. XLIII. — The tube of the flower, fig. 1, ought to be a little shorter. The lobes of the corolla, fig. 18, are too wide at base; they should be more oblong. The ovary, fig. 24, should be depressed like that in fig. 28. The calyx-segments ought to be marked in fig. 25.

III. UEBER CUSCUTA HASSIACA, Pf.

From the Botanische Zeitung, II. No. 32, August, 1844. Communicated by Alexander Braun.

Ein vor wenigen Tagen erhaltener Brief von Dr. Engelmann (datirt vom 28. Mai) enthält nachfolgende Bemerkungen über die von Dr. L. Pfeiffer im vorigen Jahre bei Kassel aufgefundene und im 41. Stück der bot. Zeitung desselben Jahres beschriebene *Cuscuta hassiaca*, welche nach den Mittheilungen von H. Mohl (bot. Zeit. 1843. 1. Stück) in demselben Jahre auch bei Weilmünster in Nassau vom Apotheker Rudio, und zwar in grosser Menge auf *Medicago sativa* beobachtet und nach einer kürzlich erhaltenen Mittheilung vom Apotheker Lehmann auch in der Gegend von Offenbach bei Frankfurt im vorigen Jahre vorgekommen ist. Ein so plötzliches Erscheinen einer vorher nie beobachteten Pflanze, gleichzeitig an mehreren entfernten Lokalitäten, musste den Gedanken an Einschleppung durch landwirthschaftliche Samen erwecken, welcher durch Engelmann's Mittheilungen Bestätigung findet. Die Kasseler Exemplare der *C. hassiaca*, auf deren Untersuchung sich Engelmann's Urtheil gründet, sind mir durch Hrn. Dr. Pfeiffer selbst zur Zusendung an denselben mitgetheilt worden.

Dr. Engelmann schreibt nun über diese Pflanze Folgendes: „Die übersendete *C. hassiaca* Pf. gehört, wie ich auf den ersten Blick sah, zu keiner der hiesigen (nordamerikanischen) Arten, dagegen ist sie ohne Zweifel identisch mit der *Cuscuta*, welche auf Ewigkleeäckern bei Genf gefunden und unter dem Namen *C. Chilensis* in verschiedenen Herbarien aufbewahrt wird. Von der wahren *C. Chilensis* Ker., von welcher ich Exemplare aus Chili verglichen habe, ist sie übrigens sehr verschieden, und Choisy in seiner Monographie der Cuscuten (Mémoires de la société d'hist. natur. de Genève. Vol. 9. part. 2, pag. 180.) erklärt sie für *C. corymbosa* Ruiz et Pavon, und giebt zugleich an, dass sie auch bei Leyden verwildert vorkomme, und dass sie zunächst aus Piemont nach [554] Genf gekommen sei. Nach Piemont sei sie mit Samen von *Medicago sativa*, den man unter dem Namen Alphapha für eine neue Futterpflanze gehalten, gekommen. Da Choisy's sowohl, als Pfeiffer's Beschreibung noch Einiges zu wünschen übrig lässt, ja erstere durchaus vag ist und die Pflanze nicht charakterisirt, so gebe ich eine neue nach Genfer Exemplaren (von Jack gesammelt) und Kasseler (von Pfeiffer mitgetheilt).

Cuscuta corymbosa, (Ruiz et Pavon sec. Choisy) : caule subcapillaceo, ramoso ; fasciculis florum subsessilibus, compositis ; floribus singulis pedicellatis, pentameris ; calycis semi-quinquefidi lobis obtusiusculis, tubo corollæ campanulato-turbinato, calycem subduplo excedente, laciniis limbi ovatis acutis, apice inflexis, erectis, demum patentibus subduplo longiore ; staminibus limbo multo brevioribus, filamentis e basi lata subulatis, antheris oblongo-linearibus, squamis fimbriatis incurvis ; stylis ovarium pyriforme (basi carnosum constrictum) æquantibus, crassis, faucem corollæ attingentibus ; stigmatibus capitatis ; capsula. . . .

Die Genfer Exemplare haben kleinere Blüthen, kürzere Blüthenstiele, eine etwas weitere Blumenröhre, breitere an der Basis etwas geöhrte Lappen der Blumenkrone, die sich auch an der geöffneten Blüthe noch decken, etwas kleinere, weniger tief zerschlitzte Schuppen und im allgemeinen eine dichtere, festere Textur der Blüthentheile. Die Kasseler Pflanze hat eine grössere, etwas mehr röhrige Blumenkrone mit nicht geöhrten, an der Basis nach dem Aufblühen sich nicht mehr deckenden Lappen, tiefer geschlitzte Schuppen, die aus der Blumenröhre hervorragen und im Allgemeinen membranösere, zartere Textur der Blüthentheile. Es sind dies Verschiedenheiten, denen kein specifisches Gewicht beigelegt werden kann, wie ich mich häufig an unseren nordamerikanischen Arten im Freien überzeugt habe. Die Kasseler Exemplare stellen die mastere Form dar, in einem nassen Jahre erwachsen! — Charakteristisch ist ausser der nicht aufspringenden Kapsel [555] (H. Mohl) und den kopfförmigen Narben, welche zwei Charactere sie mit allen amerikanischen Arten, die ich kenne, gemein hat, ganz vorzüglich : Die verkehrt-conische Gestalt der Blumenröhre ; die eingeschlagenen spitzen Zipfel des Saums der Blume ; die dicken pfriemenförmigen Filamente ; die fast linienförmigen Antheren ; die dicken kurzen Griffel und zumal die birnenförmige, fast keulenförmige Gestalt des Ovariums, dessen oberer Theil die Höhlen für die Ovula enthält, während der untere, eingeschnürte dicht ist. Es ist wahrscheinlich, dass die verdorrte Blumenkrone die Kapsel haubenförmig bedeckt, vielleicht auch sie ganz umgiebt. Untersuchung der *reifen* Kapsel und Durchschnitte des *frischen* Ovariums wären zu wünschen.

Aus Choisy's Monographie wird man jetzt wohl auch in Deutschland den südamerikanischen Ursprung der *C. hassiaca* erkannt haben. Es wäre unrecht, wenn sich in Europa eine kopfnarbige *Cuscuta* fände, da die geographischen Grenzen der beiden Abtheilungen der Cuscuten so schön und bestimmt sind. Ganz Europa, ganz Afrika, Asien bis zum westlichen Indien, gehört den fadennarbigen Cuscuten ; ganz Amerika, ganz Australien und die Grenzen des stillen Meeres, China und das östliche Indien den kopfnarbigen.

Die Abbildung der *C. corymbosa* in Ruiz und Pavon t. 105. f. 6. kann ich übrigens leider nicht vergleichen ; es bleibt daher noch einer genaueren Vergleichung vorbehalten, ob Choisy's Bestimmung der aus Chili nach Europa gewanderten Art richtig ist.

Ich füge diesen Mittheilungen meines amerikanischen Freundes blos noch die Bitte an die deutschen Botaniker bei, fernere Beobachtungen über das Vorkommen der eingewanderten *Cuscuta* mitzutheilen.

Carlsruhe, den 13. Juli 1844.

IV. BEMERKUNGEN UEBER CUSCUTEN.

From the Botanische Zeitung, Vol. IV. No. 16, April 17, 1846. Communicated by Alexander Braun.

Da die Cuscuten, ungeachtet des vielseitigen Interesses, welches sie bieten, zu den verhältnissmässig noch wenig gekannten Pflanzen gehören, indem selbst über die in Deutschland vorkommenden Arten die Akten noch lange nicht geschlossen sind, so scheint es mir nicht unzweckmässig, einige Bemerkungen über diese Gewächse zur Oeffentlichkeit zu bringen, welche mir mein Freund Engelmann in St. Louis in seinem letzten Briefe mitgetheilt hat. Ich werde denselben später einige eigene Beobachtungen anhängen, durch welche ich zur Naturgeschichte der Arten der deutschen Flora einige Beiträge zu liefern hoffe.

NATÜRLICHE ANORDNUNG DER ARTEN DER GATTUNG *CUSCUTA* NACH G. ENGELMANN (JULI, 1845).

I. Cuscutæ stigmatibus elongatis, capsulis circumscissis :

A. Ovario conico, stylis coalitis :

a. Stylis omnino coalitis : 1. *C. monogyna*, Vahl. 2. *C. astyla*, E.

b. Stylis basi coalitis : 3. *C. macrantha*, Don. 4. *C. pedicellata*, Ledeb.

B. Ovario globoso, stylis a basi distinctis :

a. Ovario majore, stigmatibus cum stylis brevioribus ovarium æquantibus vel eo brevioribus : 5. *C. Epilinum*, Weihe. 6. *C. Europæa*, Auct. (*major*, C. Bauh., Chois.). 7. *C. Arabica*, Fresen. — ANMERK. In diese Abtheilung gehören noch mehrere Formen aus dem südlichen Europa und von den canarischen Inseln, deren specifische Charaktere noch [274] nicht hinreichend ausgemittelt sind.

b. Ovario minore, stigmatibus cum stylis æquantibus ovario multo longioribus : 8. *C. Epithymum*, Sm. (*minor*, C. Bauh., Chois.). 9. *C. cupulata*, E. 10. *C. planiflora*, Tenore (vorausgesetzt, dass die im südlichen Tyrol auf *Colutea* wachsende Art wirklich diese ist).

II. Cuscutæ stigmatibus capitatis, capsulis indehiscentibus (baccatis):

A. *Gerontogeæ :* (Die Mehrzahl derselben ist noch nicht hinreichend untersucht, um unter die amerikanischen Arten am rechten Orte eingereiht zu werden ; hierher z. B.). 11. *C. ciliaris*, Kotschy. 12. *C. sulcata*, Roxb.

B. *Americanæ :*

a. Chlorocarpæ s. depressæ, ovario sine stylopodio, globoso-depresso, capsula membranacea, e flavo virescente :

α. Corolla capsulam maturam calyptræ instar obtegente :

* Stylis ovarium æquantibus : * 13. *C. Cephalanthi* (s. *tenuiflora*), E.

** Stylis ovario longioribus : 14. *C. Americana*, L. * 15. *C. cuspidata*, E.

β. Corolla ad basin capsulæ persistente :

* Stylis ovarium æquantibus : * 16. *C. pentagona*, E. * 17. *C. Polygonorum* (s. *chlorocarpa*), E. * 18. *C. umbellata*, Torr. (aus dem Felsengebirg, ob identisch mit der von Humboldt so benannten aus Neuspanien, ist noch zweifelhaft). * 19. *C. verrucosa*, E.

** Stylis ovario multo longioribus : * 20. *C. Californica*, Chois.

b. Phæocarpæ s. umbonatæ, ovario stylopodio coronato, plus minusve umbonato vel rostrato, [275] capsula brunnea, firmiore :

α. Corolla membranacea, marginibus integris :

* Calyce gamosepalo, bracteis paucis remotis suffulto : * 21. *C. vulgivaga*, E. * 22. *C. Saururi*, E. * 23. *C. rostrata*, Shuttlew. 24. *C. Bonariensis*, Hort. 25. *C. Chilensis*, Bot. Reg. 26. *C. suaveolens*, Ser. (*hassiaca*, Pf.).

** Calyce 5-sepalo, bracteis sepaloideis, pluribus suffulto : * 27. *C. glomerata*, Chois. * 28. *C. compacta*, Juss. * 29. *C. adpressa*, E.

β. Corolla carnosa, margine crenulata. * 30. *C. Coryli* (s. *crenulata*), E. * 31. *C. neuropetala*, E. * 32. *C. hispidula*, E.

Die vorstehende Uebersicht enthält blos diejenigen Arten, welche von Engelmann selbst untersucht worden ; alle ihm noch nicht durch eigene Untersuchung oder nur aus unvollständigen Exemplaren bekannten sind nicht aufgeführt. Welchen Zuwachs an genau unterschiedenen Cuscuten Nordamerika durch Engelmann's Bemühungen in den letzten Jahren erhalten hat, ergiebt sich aus der Vergleichung von Engelmann's "Monographie der nordamerikanischen Cuscuten," in *Sillimann's Am. Journal*, Vol. XLIII. (1842), p. 333, et s. mit den in obiger Aufzählung vorkommenden (durch ein Sternchen bezeichneten) in Nordamerika einheimischen Arten. In der erwähnten Monographie sind mit Einschluss von *Lepidanche*, welche Gattung Engelmann jetzt wieder mit *Cuscuta* vereinigt hat, 8 Arten beschrieben, während die hier gegebene Uebersicht deren 16 enthält. Von südamerikanischen Cuscuten, die an Zahl die nordamerikanischen wahrscheinlich

noch weit übertreffen, konnten wegen mangelhaften Materials nur wenige aufgeführt werden. Alle bisher bekannt gewordenen amerikanischen Cuscuten gehören in die Abtheilung derer mit kopfförmigen Narben; nach Choisy würde von dieser Regel *C. micrantha*, Chois. aus Chili, welche in Choisy's Monographie und De Candolle's Prodromus in der Abtheilung der Cuscuten mit verlängerten, fadenförmigen oder keulenförmigen Narben vorkommt, eine Ausnahme machen, allein Choisy's eigene Abbildung zeigt kopfförmige Narben. Auch die Cuscuten Australiens haben alle kopfförmige Narben. Uebrigens sind einige der europäischen Cuscuten mit verlängerten [276] Narben in Amerika eingewandert, so namentlich *C. Epilinum*.

V. SYSTEMATIC ARRANGEMENT OF THE SPECIES OF THE GENUS CUSCUTA, WITH CRITICAL REMARKS ON OLD SPECIES AND DESCRIPTIONS OF NEW ONES.*

From the Transactions of the Academy of Science of St. Louis, Vol. I. No. 3, 1859.

The genus Cuscuta belongs to the natural order of *Convolvulaceæ*, to which, indeed, it has been attached by almost every botanist, and from which it cannot be separated, though the embryo is very distinct, being rather a minute plant than an embryo in the usual form, the tip forming a plumula, often provided with alternate scales, and without cotyledons proper. Nor ought such a natural group of plants to be split into a number of genera on subordinate characters, as has lately been proposed, and in some instances, too, upon erroneous observations.

The characters which furnish good grounds for a subdivision of the genus are found in the shape of the styles and stigmata and in the fruit. These same characters, it must be admitted, have been used in separating the old *Convolvuli* into numerous genera, and even tribes; so that analogy would justify or even require a similar division of *Cuscuta;* but even Choisy, the author of many of these new convolvulaceous genera, in his Monograph and in De Candolle's Prodromus, admits the propriety of keeping *Cuscuta* united. Splitting *Convolvulus* into numerous genera may be excused, or perhaps justified by the necessity of separating the large crowd of species into a number of groups. This law of expediency, however, can have no scientific value, and can certainly not be pleaded in regard to such a natural, easily recognized, and not too numerous genus, as *Cuscuta* is.

The subdivisions proposed are based, as has been stated, on the shape of the styles and stigmata, and on the capsule.

The *styles*, typically always two, usually are distinct; or they are united in their whole length, or nearly so. They are of equal thickness throughout, or are thicker at base (subulate), or thickened towards the top (club-shaped); they are of equal length in one group, and unequal in another.

The *stigmata* are cylindric, elongated, and of the same thickness as the styles, or thinner; or they are oblong, or oblong-elongated, and thicker than the styles; or they are subulate from a thick base; or we find them capitate (or, as they are often, though wrongly, called, globose), hemispherical, or somewhat flattened on the upper, and flattened or usually impressed at the lower surface at the insertion of the style. In a single species, the stigmatic surface of the dilated top of the style is lobed, and in the centre somewhat depressed.

The *capsule* is either circumscissile, opening transversely by a regular joint, with [454 (4)] thickened edges; or it bursts transversely with an irregular, jagged margin; or it remains closed (it is baccate, as it is termed), and either falls out of the persistent calyx, or it finally falls off with the calyx.

* See also Latin translation by Ascherson, with preface by A. Braun, published under title "Generis Cuscutæ species secundum ordinem systematicum dispositæ adjectis in prius jam notas observationibus criticis nec non novarum descriptionibus, auctore Georgio Engelmann, M.D." Berlin, 1860; pp. 8 + 87. — Eds.

Between both styles of the ripe and dry capsule an opening is observed — the intrastylar aperture — parallel with or transverse to the dissepiment, more or less rhombic, formed by an incomplete separation of both carpels, which compose the capsule. This separation takes place in that triangular and thickest part of the dissepiment which lies next to and below the styles, and which, in the species with circumscissile fruit, adheres to the top, while the greater and thinner obcordate or bilobed part of the dissepiment remains attached to the base of the capsule in the bottom of the calyx.

In most instances the stylar portions of the dissepiment, as I will call this part, remain united at base, separating the funnel-shaped intrastylar aperture from the interior cavity of the capsule, and therefore cannot give egress to the seeds, as has been erroneously stated. This is, I believe, the case with most or all American *Cuscutæ* (*Grammica*). In *Eucuscuta* and *Epistigma* the intrastylar aperture does communicate with the cells of the capsule, but the opening is far too small to let the seeds out; nor would this be necessary, as in all of them the capsule is circumscissile. In some few species I find each stylar portion of the dissepiment divided into two halves; in *C. pedicellata* these halves are widely distant from one another and adhere to the opposite halves, so as to form an opening into the capsule transverse to the dissepiment.

In *Monogynella* and *Callianche*, where the styles are united, there is, of course, no intrastylar opening, and in the former the entire dissepiment remains in the bottom of the capsule; in the latter, a small triangular stylar portion adheres to the top of the capsule, but, of course, without any opening.

Des Moulins was the first, in his "Études," to draw attention to the shape of the seed in general and the direction of the hilum in particular. Where all the four seeds are well developed, they are triangular, with a larger exterior convex and two smaller flat surfaces, the latter facing the dissepiment and the other seed of the same cell; the top of the seed is rounded or acutish; the base, with which it is attached to the placenta (which itself is dilated into a disc, often cup-shaped), is obliquely truncate or somewhat hooked, or rostrate, as Des Moulins terms it. Both flat faces of the seed are equal, or the one directed towards the dissepiment is larger than the other. At the truncate base of the seed, in the centre of a smooth and roundish umbilicus, is the hilum, forming a longer or shorter, narrower or broader linear groove, sometimes reduced almost to a point; it runs [455 (5)] in the direction of the interior angle of the seed (*longitudinal*, DesM.), or at right angles with it (*transverse*, DesM.), or it has an intermediate, oblique direction. In some sections I find these characters sufficiently distinct; in others they seem to be less reliable; in the American *Cuscutæ* I have often found them intermediate, and variable, often in seeds from the same capsule. Wherever only one or two seeds in a capsule come to maturity their shape becomes less distinct, and offers no good characters. It is scarcely necessary to add that only ripe seeds ought to be examined; unripe ones, especially when pressed hard, have led to the strangest mistakes; winged or margined seeds described by authors are such unripe seeds. Nearly ripe seeds are smoother and larger, when soaked, than ripe ones.

The embryo has been supposed to offer good characters; but I have reason to believe that those embryos with one or few circumvolutions (such as the one figured by Webb, Phyt. Can. III. pl. 142, fig. 14) are taken from unripe seeds.

Another character which I at one time relied on for generic distinction of *Cuscutæ* is found in the calyx. Usually it is gamosepalous, but in some American species it is formed of entirely distinct and imbricate sepals, not different from the surrounding bracts, — a character which prevails in *Convolvulaceæ* proper, where only one genus (*Wilsonia*) is gamosepalous.

The specific characters of *Cuscutæ* are found in the thickness of the stem, but principally in the inflorescence and in the different organs of the flower and fruit.

The inflorescence together with the presence or absence of bracts within it offers good characters; less so, the presence or proportion of pedicels.

The shape and proportion of calyx and corolla and of their parts (tube and lobes) furnish important but not unchangeable characters. Their texture must also be studied, and often gives an important clue to the distinction of species.

It is unnecessary to repeat what has been said by former monographers about these points, but it may not be useless to indicate a few facts not so clearly stated by them.

The tube of the calyx, generally more or less campanulate or hemispherical, is angular in some species, the angles corresponding to the commissure, or to the midrib of the sepals. Its lobes are more or less deeply divided, and are often auricled at base, and overlapping; these characters, however, are not very constant and reliable, as they not rarely depend on the rich nourishment and consequent vigorous growth of the parasite. The texture of the calyx is homogeneous in some species, and either fleshy or membranaceous (often very thin, shining, or semi- [456 (6)] transparent, when dry), with a small or large reticulated cellular tissue; or it exhibits, especially along the middle and towards the base an aggregation of warts or tubercles; these, also, are not constant in all the forms of the species. In other species, the tissue shows roundish or elongated pellucid dots or cells (glands, as they are usually called), very distinct in dried and then soaked specimens.

The tube of the corolla is cylindric or campanulate, or rather hemispherical or quite shallow, but never urceolate or ventricose during the flowering period; the swelling of the impregnated ovary, however, often gives it that shape. The laciniæ[1] of the corolla are of different shape, and direction, and proportion, and also sometimes auriculate and imbricate at base; their points are occasionally incurved, or their margins revolute, or involute; their margin, usually entire, is sometimes crenulate. The texture of the corolla is similar to that of the calyx, but never, I believe, verrucose, though often glandular. Its cellular structure will yet, I suspect, offer good characters for some species, the cells being of very different size and shape in different species. The corolla, and sometimes the calyx, is occasionally covered with small papillæ, which probably represent hairs, giving it a mealy appearance. This character, apparently so striking, is, however, of no more specific value than the pubescence in other plants, as I find papillose varieties of a number of European (*C. planiflora, C. Babylonica*) and American (*C. decora, etc.*) species, of course with intermediate forms. Of a single species (*C. capitata*), I know only the papillose form.

The calyx is always persistent; the corolla is deciduous only in the Indian *C. reflexa;* in all the other species it remains adhering to the capsule, either to its base, or, hood-like, to its top, or it completely envelops it, but it is not properly persistent; it is distended from the swelling of the capsule, but does not seem to grow. The position of the dead corolla is usually constant.

The stamens are mostly inserted in the very throat of the corolla, alternating with the laciniæ, but often exteriorly covered by their overlapping bases. In *Callianche* and *Monogynella* their point of insertion is usually below the throat, and the filaments are very short. The filaments in the other *Cuscutæ* are more or less flattened, linear, or subulate; of different lengths, but usually much shorter than the laciniæ; they are rarely absent. The anthers are orbicular, ovate, oblong or linear, cordate or sagittate, blunt, emarginate, or apiculate, large or small; but their [457 (7)] shape or size do not afford good and constant characters in this genus.

The most peculiar organs of the flower are the epistamineal scales, which are found in most of the species. The simplest form of that organ (in *C. inflexa, C. chlorocarpa, etc.*) exhibits a few teeth or lobes laterally adhering to the lower (attached) part of the filament. These lobes in other species expand into membranes, forming two lateral wings to the filament, crenulate or fringed at the tip and outside; then these wings partly unite at their upper end, thus forming a single bifid scale; finally they unite entirely, forming an oblong, ovate, spatulate or truncate, more

[1] I shall use the word *laciniæ* for the divisions of the corolla, and *lobes* for those of the calyx.

or less crenate or fimbriate scale. Towards the base the scales are always "adnate in the middle," or, properly speaking, attached to both sides of the adnate filament. Their bases usually connect with one another, forming inverted arches.

In the following species these scales are wanting: *C. grandiflora* and *C. prismatica* of South America, *C. hyalina* of Asia, *C. Californica*, and *C. Sandwichiana*. In *C. Californica* the inverted arch alone is present, entire or fringed; in the others I find no trace of scales at all.

These scales are evidently lateral dilatations of the lower (attached) part of the filaments, perhaps of the character of stipules, as Professor A. Braun suggests; or they are a sort of stamineal crown, attached at base to the corolla, but not a duplication of the same.

The presence, form, and size of the scales furnish some of the best characters in this genus, but they are not entirely reliable; and while in some species they are very constant, in others they are found to vary considerably. It is doubtful whether a really scaleless form of *C. Europæa* exists; *C. Californica*, usually without scales, seems to occur also in a variety with scales.

The ovary and pistils are more reliable for the determination of species, just as they furnish the most important characters for the distinction of the sections. The walls of the ovary are of equal thickness throughout, or they are thickened towards the base of the style (furnished with a *stylopodium*, as I formerly designated this form). The ovary is smaller than the tube of the corolla, or it fills its whole cavity, or even protrudes from it. The styles are subulate or terete, thick or capillary, and very constant in these differences. Their length, however, is variable; and this character, so much relied on by Choisy in the subdivisions of this genus in his Monography and in DC. Prodromus, is of secondary importance, as the same species sometimes occurs with short or with long styles, and as the styles, included at first, often become exsert [458 (8)] with age. The direction of the styles in the flower and on the fruit furnishes a tolerably good character.

The position of the dead corolla on the capsule has already been mentioned as a pretty reliable specific character. The shape and even the texture of the capsule also ought to be noted, though in several species (*C. Europæa*, for example) its form is quite variable.

The number of seeds which ripen in each capsule furnishes no distinction, though the species with very crowded flowers, and some others with loose flowers also, often develop only one or few seeds. The shape and surface of the seed ought to be studied more, and will yet, it is believed, help to distinguish some species.

As almost all the characters enumerated above are subject to more or less variation, it is necessary to base the diagnosis of a species on a combination of a number of characters; but as the value of these characters is necessarily differently estimated by different botanists, some will consider as well-marked species what others will look upon as mere varieties.

The different species often seem to have a predilection for certain plants, or families of plants, for their sustenance; and I have myself at times thought I discovered an influence of the mother plant (or, better, nursing plant, nurse) on the form and development of the parasite. But I have become fully convinced that this influence is very limited, and probably goes not even farther than the influence of different kinds of soil and manure would go with any other plant. If some species seem very constantly to prefer certain plants to others (*C. Europæa*, *Urtica dioica*; *C. Epithymum*, *Calluna vulgaris* or *Genista sagittalis*; *C. chlorocarpa*, *Polygonum*; *C. Gronovii*, *Cephalanthus*; *C. lupuliformis*, *Salix*; and, the most marked example, *C. Epilinum*, the flax fields), it is probably because the kind of soil, the humidity or dryness, the shade or sun, and all the circumstances which suit the nurse, also agree best with the parasite. On the whole, succulent herbaceous dicotyledonous plants suit them best as nurses; some few species prefer low shrubs or semi-shrubs; and most of the *Monogynellæ* and a few others affect larger shrubs and trees, of course penetrating only the tender bark of the smaller limbs.

Cuscutæ are found also on acrid or poisonous plants. I have seen them on *Ranunculaceæ*, on *Euphorbiæ*, on *Cicuta* and other *Umbelliferæ*, on *Rhus Toxicodendron*, and others. I have seen them also, though sparingly and not very thrifty, on *Monocotyledoneæ*, — such as *Liliaceæ*, *Gramineæ*, and others, — and even on the siliceous epidermis of *Equisetum*. The fact is that, when once attached to a nursing stem, they throw out their branches and coil around any plant in the neighborhood, and strike their suckers into the tissue, and grow on anything that can furnish [459 (9)] them nourishment, even on their own branches and flowers. This is even the case with the most exclusive species, *C. Epilinum*, which attaches itself to all the weeds growing in flax fields, and may be cultivated on *Vicia*, *Impatiens*, and many other plants. Rich nourishment on succulent plants expands the organs, enlarges the flowers, increases the whole plant, and thus gives rise to varieties which at times have been distinguished as species. *C. Epithymum* in clover fields becomes what has been called *C. Trifolii*; *C. Europæa* on vetches, *C. Viciæ*; *C. Gronovii* in shaded miry soil, on *Saururus*, *C. Saururi*; the overgrown form of *C. Africana* is *C. Capensis*, etc.

The *haustoria* (suckers) of *Cuscuta* deeply penetrate into the tissue of the nurse, and they, with parts of the stem imbedded in this tissue, are able to reproduce the plant after all external vestiges of the stem have been rubbed off. This the gardeners often have occasion to deplore in regard to a variety of *C. Epithymum* which has become a pest to some greenhouses in Europe. I have observed the same fact in different species which I have had under cultivation, especially in *C. inflexa*.

The species of *Cuscuta* naturally arrange themselves in three large groups, distinguished by their styles and stigmata.

1. Those with *two equal styles and elongated stigmata*. They are natives of the Old World exclusively, and have rarely and only temporarily been introduced with cultivated plants into America. (*C. Epilinum* with flax into some of our Eastern States, and *C. Europæa* with vetches in Hayti.) They may be termed *Cuscuta* proper. (*Cuscuta* and *Epilinella*, Pfeiffer, Bot. Zeitg. III. 673; *Cuscuta*, *Epilinella*, and *Succuta*, DesM. Et. pp. 38–41.)

2. Those with *two unequal styles, and abbreviated, usually capitate, stigmata*. They abound in America and Oceanica, and in the southern and eastern parts of Asia; a few species even penetrate into western Asia and southern Europe, and a single species is found in southern Africa. Cultivation has temporarily introduced one species into Europe (*C. racemosa* from Chili, under the name of *C. suaveolens*). This group may be comprised under the name of *Grammica*, — a genus established by Loureiro in his Flora Cochinchinensis, I. 212, on a species belonging here. (*Engelmannia*, Pfeiffer, Bot. Zeitg. III. 673, not Torrey and Gray, nor Klotzsch; *Pfeifferia*, Buchinger Ann. Sc. Nat. IX. 88, not Salm-Dyck; *Buchingera*, F. Schultz in Jahrb. Pharm. 1847; *Cassutha*, DesM. Et. 40; *Grammica*, DesM. Bull. Soc. Bot. France, I. 295; *Cuscutina*, Pfeiff. Bot. Zeit. 1846, p. 461.)

3. Those with *styles united entirely or partly, and with capitate, ovate, or conic stigmata*. [460 (10)] The species of this group, all distinguished by their large size and thick stems, principally inhabit Asia; two extend into southern and eastern Europe; and two others are found in South Africa and southern North America. This group is Des Moulin's (Et. 39) *Monogynella*, with a little altered character.

The modifications in the form of the stigma and the dehiscence of the capsule furnish the basis for a further subdivision of the three principal groups. I will here only say that in *Cuscuta* proper the capsule is almost always circumscissile; in *Grammica* it is often so, but more commonly it remains closed; in *Monogynella* it is constantly circumscissile.

The dead corolla covers the whole or the top of the capsule always, with a single exception (*C. Africana*), in the first; it is found on the top, or at the base of the capsule, in the second; and, if not deciduous, always on its top in the third group.

The following sections are proposed : —

A. *Cuscuta Group.*

1. **Eucuscuta.** Styles nearly as long or longer and as thick or thicker than the filiform stigmata; capsule regularly circumscissile.
2. **Epistigma.** Subulate stigmata nearly sessile ; capsule opening transversely without a regular jointed separation.
3. **Clistococca.** Subulate styles longer than the short subulate stigmata; capsule baccate.
4. **Pachystigma.** Cylindric or oblong stigmata thicker than the filiform styles; capsule bursting transversely.

B. *Grammica Group.*

5. **Eugrammica.** Stigmata capitate; capsule more or less irregularly circumscissile.
6. **Clistogrammica.** Stigmata capitate; capsule baccate.
7. **Lobostigma.** Top of clavate styles lobed at the upper stigmatose surface.

C. *Monogyna Group.*

8. **Monogynella.** Stigmata capitate or ovate, united or distinct.
9. **Callianche.** Stigmata conic, or almost subulate ; corolla large and deciduous.

Sect. 1. EUCUSCUTA.

Styles filiform, terminating in filiform stigmata of the same length or shorter, rarely longer, and of the same thickness as the styles, or thinner towards the end. Capsule regularly circumscissile by a joint, the line of separation being thickened. Usually all four seeds ripen ; they are triangular, with an obliquely truncate base, the hilum forming a narrow perpendicular line.

The flowers are mostly sessile and densely clustered, forming globose heads in the axils of single [461 (11)] bracts without bracts in the inflorescence. The central flowers open first ; the exterior ones are occasionally abortive. *C. Epithymum* has sometimes short pedicels, and *C. Babylonica* is always pedicelled. The corolla always remains on top or around the capsule, never at its base. Epistamineal scales are always present, though sometimes very thin and small, and easily overlooked.

The species of this group inhabit Europe, western and central Asia, and northern Africa to the Canary Islands.

§ 1. Styles longer than ovary.

1. C. **Babylonica**, Aucher! mss.; Choisy! Cusc. 174, t. 1, f. 1; DC. Prod. IX. 453. *C. pedunculoris*, Kotschy! in sched. — Well characterized by its pedicelled flowers, truncate calyx and almost entire scales; approaching by its inflorescence to those other Asiatic species comprised in the section *Epistigma*. — Bagdad, Aucher-Eloy! 1420 and 3183; on the Tigris, Noë ! in Kurdistan, Kotschy! 388, a.

Var. **elegans**. *C. elegans*, Boiss. & Balansa! Diag. Or. II. 3, 129, from the alpine regions of the Taurus, Balansa! 708; scarcely distinct from *C. Babylonica* except by the papillose prettily rose-colored flowers, and by the scales being a little more dentate and somewhat incurved.

2. C. **Epithymum**, Murray in L. Syst. ed. 13. *C. Europæa*, β, L. Sp. 180. *C. minor*, Bauh. Pin. 219; DC. Fl. fr. III. 644 ; DC. Prod. IX. 453. *C. filiformis*, β, Lam. Fl. fr. II. 307. — To this well known and common European species some authors have assigned all the different forms I am going to enumerate below, while others have separated several of them as distinct species; others, again, have united with it a number of other forms which I must consider distinct, especially such as I class with *C. planiflora ;* some have even mixed up with it the very distinct *C. Europæa*.

It is certainly difficult to make precise the limits of *C. Epithymum* and *C. planiflora*, and some forms which I class under var. *Kotschyi* of the former, and others which fall under var. *approximata* of the latter, apparently are more closely allied than the extremes of either species among themselves; while the common *C. Epithymum*, especially the form known as *C. Trifolii*, is as distinct as can be from Tenore's original *C. planiflora*. I arrange the different forms in the following order : —

Var. *a*. **vulgaris**, the common form of central Europe extending west to Great Britain, north to Scandinavia, south to northern Spain (Bourgeau ! 655), northern Italy (*C. acutiflora*, Rota !), and also [462 (12)] Naples, to the Crimea, and reaching eastwardly far into Asia (Caucasus, Hohenacker! 409 and 1939, Altai, Ledebour ! "Orient" Herb. Tournefort!). It varies considerably, especially in the size and proportion of the calyx and its lobes, and transition forms, uniting it with the other varieties, are not rare. I have paid some attention to the proportion of the stigma and style, but find no permanent character in them; the style proper is longer or shorter than the stigmatic portion; and this part is cylindrical or subulate in specimens not otherwise distinguishable; the stigma is usually pale brown-red, or, when dry, dark red, rarely yellowish. — *C. Trifolii*, Babington! sometimes so fatal to whole clover fields in England, France, Switzerland, Germany, and Sweden, is a luxuriant form, overgrown at the expense of the succulent herb, which it destroys.

Var. β. **macranthera**. *C. macranthera*, Heldr. & Sart.! in sched.; Boiss.! Diag. Or. II. 3, 126. *C. Calliopes*, Heldr. & Sart.!; Boiss.! ibid, 128. — Large flowers on very short pedicels; calyx short, its ovate lobes scarcely covering half of the tube of the corolla; laciniæ ovate, acute or obtusish; anthers oval, large, often longer than the filaments;

scales usually shorter than the tube, sometimes quite narrow. — A southern form, found on the southern declivity of the Alps, in Piedmont, Tyrol, Spain (Willkomm! 52, a), in southern France, in Italy (on the Apennines and in Corsica), in Greece and in the Crimea; I have also seen, in the Kew Herbarium, an English specimen of this variety, on *Ulex;* it has made its appearance in greenhouses on *Erica* and other evergreen shrubs; this garden form is *C. xanthonema* of the Paris Jardin des Plantes.

Var. γ. ? OBTUSATA. This very curious form was collected by Funk! (Herb. Cosson and Hb. Reichenbach) in the Sierra Nevada of Spain on some shrubby *Genista;* the glomerules consist of 3–5 flowers, only, on pedicels longer than the calyx; lobes of calyx and corolla broadly oval, obtuse, shorter than the tube of the corolla; scales large; styles as in the common form. I would at once have acknowledged this peculiar plant as a distinct species, if a second specimen had not come to hand, collected by Heldreich on *Artemisia* near Koniah in the interior of Asia Minor, which approaches more to the ordinary form; flowers similar, but smaller, sessile, 6–8 in a small head; scales narrow; styles ordinary, seeds very small (0.3 lines diam.). The former may be distinguished as var. *macropoda,* the latter as var. *apoda.*

Var. δ. ? SAGITTANTHERA;[2] allied to var. *angustiloba,* distinguished by the loose glomerules; pedicels [463 (13)] as long as calyx; lobes of calyx obtusish, scarcely as long as tube of corolla; laciniæ lanceolate, acute; anthers broadly sagittate; scales large, crenulate; styles subulate at base, on the capsule almost horizontally divaricate. — Tunis, Kralik! Herb. Cosson and Herb. Mus. Florent.; the only African form of the group of *Epithymum* seen.

Var. ε. ANGUSTATA. I distinguish by this name an Italian form, which assumes different shapes, described under different names. It has narrow and elongated lobes of the corolla and usually also of the calyx, which is commonly longer than the tube of the corolla; the flowers are numerous and sessile, or ordinarily more or less pedicelled. Three sub-varieties may be distinguished.

Var. a. *alba,* with whitish stems, smaller flowers, membranaceous calyx. This is the true *C. alba,* Presl! Del. Prag. 87, also of Tenore and some other Italian botanists, while most authors apply this name to the original *C. planiflora,* Ten. Presl's description, copied by almost every subsequent author, is very erroneous; but his own specimens, on *Zizyphus,* preserved in his collection at Prague, and in the imperial Herbarium at Vienna, leave no doubt about the identity of the plant. *C. subulata,* Tineo! in Gussone Fl. Sic. II. 888, is exactly the same thing, as also *C. Gussoni,* Gasparrini! in Hb. It is a southern form occurring principally in Sicily, also about Naples and in Malta; it is often found on shrubs, and Sieber! (in Herb. Ledebour) gathered it on an oak.

Var. b. *angustissima,* flowers longer than in any other form seen (2¼–2½ lines long), on short pedicels, with short calyx, slender elongated tube, narrowly lanceolate acuminate laciniæ, distinctly subulate filaments, and rather small scales. In fields of *Medicago* near Padua, Visiani!

Var. c. *rubella,* with red stems, larger flowers, red calyx of a thicker texture. This is *C. planiflora,* Koch Fl. Germ.; DesM. Et. 54, and many other authors, but not of Tenore. It has often been collected in southern Tyrol on *Colutea, Artemisia,* etc.; it also occurs in the Abruzzi and in Corsica.

Var. ζ. KOTSCHYI. *C. Kotschyi,* Des Moulins! Études p. 56 (not *C. Kotschyana,* Boiss.). *C. microcephala,* Welwitsch! in sched. Flor. Lusitan. nro. 1048. — This plant is perhaps the original *Epithymum* of the old botanists, as it often occurs on *Thymus* and other small frutescent *Labiatæ.* It is well characterized by rather thick red stems, the small and dense glomerules, the closely sessile flowers, with long acute or acuminate lobes of [464 (14)] calyx and corolla, and rather shorter styles than the common form of *C. Epithymum.* When the base of the calyx is elongated into a pedicel, it becomes the form just mentioned as *rubella.* — On the higher mountains of southern Europe, the southern declivity of the Alps, the mountains of the Dauphiny, the Pyrenees, the Sierra Nevada and other mountain regions of Spain and Portugal; in the Abruzzi of southern Italy, in the mountains of central Sicily, of Turkey, and of Greece.

Var. *scabrella* from Sicily, Gussone! and Arragon, Webb! is a papillose form of the same plant.

3. C. ABYSSINICA, Richard, Abyss. II. 78, *C. macrostyla,* Decaisne in Herb. Mus. Paris., seems to be well distinguished by the short and thick lobes of the calyx, the very long and narrow, erect laciniæ, the small, often bifid, scales, and the very long capillary styles. These even surpass those of the last species, while the other characters, together with the crowded, closely sessile flowers, approach it to the next one. The typical form was collected on *Lantana;* another, with shorter laciniæ, was gathered on a leguminous shrub.

4. C. PLANIFLORA, Tenore, sensu latiori. This name has, like that of *C. alba,* suffered under the misfortune scarcely ever to be applied to the species on which the author originally bestowed it! The difficulty was increased by an incomplete description, and by Prof. Tenore himself inadvertently distributing under his new name a form of

[2] Philologists will blame this "vox hybrida," but daily experience teaches us, and philological research confirms, that words are not formed according to theories, nor languages in the closet. The actual necessities of a living people are not bound by such rules of unity, as little as these prevail in the formation of nations, — the present fashionable theory of political nationalities to the contrary notwithstanding.

C. Epithymum; even now he preserves in his own herbarium, under this name, forms of several other species, besides the very specimen described and figured by him as *C. planiflora*, easily recognized by the well-figured *Plantago lanceolata* on which it grows. But this is not the only, nor the principal, cause of the difficulties under which botanists have labored in regard to this plant. It is probably the most variable of all the species of this genus, and appears under a larger number of forms than any other. Well may botanists differ from the view that I take in regard to this species, but it has not been adopted lightly. With 150 to 200 specimens from Europe, Africa, and Asia, before me, I have found it impossible to separate, specifically, the different forms here brought together; and even the subspecies, enumerated below, cannot always be limited satisfactorily. On the other hand I find it difficult to keep this species, or complex of forms, as I am inclined to call it, separate from some allied species. Some varieties approach to *C. brevistyla*, others to *C. Palæstina*, and others again are difficult to distinguish from the alpine form of *C. Epithymum* (*Kotschyi*).

The long list of synonyms properly belongs to the different subspecies; for the species, as I take it, [465 (15)] no synonym, nor even a name, exists: the one adopted by me is the earliest one given to any one of the forms.

Synopsis of the forms of C. planiflora.

a. Lobes of the calyx more membranaceous than fleshy; laciniæ of the corolla turgid only at the points; styles much longer than ovary.

* Calyx cupulate, lobes usually broad and short, and, like the short laciniæ, cuspidate: Var. *approximata.*

** Calyx more deeply divided, its lobes and the laciniæ narrow, elongated, acute: Var. *Schiraziana.*

b. Lobes of the calyx thick and turgid; laciniæ turgid and often cucullate at tip; styles longer than ovary, usually shorter than or as long as capsule.

* Flowers larger; lobes of calyx united above the middle or almost to the point: Var. *Webbii.*

** Flowers usually smaller; sepals almost distinct.

† Flowers smooth: Var. *Tenorii.*

†† Flowers mealy or warty: Var. *papillosa.*

Var. *α.* APPROXIMATA. *C. approximata*, Babington! Ann. & Mag. Nat. Hist. 1844, pl. 4., and 1845, pl. 1.; A. Braun! Berl. bot. Zeitg. 1844, p. 542, and in Jahrb. d. Ver. f. N. K. Nassau, 1851, t. 1, f. 1. *C. urceolata*, Kunze! in Flora, 1846, p. 651. *C. cupulata*, Engelm.! in Bot. Zeitg. 1846, c. 276. *C. planiflora*, Kunze! in Flora, 1846, p. 655. *C. leucosphæra*, Boiss. & Heldr.! in sched. (afterwards referred by Boissier Diag. Or. 1. II. 127 to *C. urceolata*). *C. Asiatica*, Pallas! in Herb. H. Bot. Petropol. — The name, *approximata*, was given to this species for the closely approaching halves of the scales; yet, it more appropriately signifies the close alliance with the last species, and especially with its last mentioned variety. The original *C. approximata* was found in fields of *Medicago* in England, Germany and Switzerland, undoubtedly an imported plant, as Babington already states, probably from India; or perhaps from southeastern Europe or Asia Minor. In this cultivated plant the flowers are larger ($1\frac{3}{4}$–2 lines long), more attenuated at base, the scales appressed, short and often bifid. Similar forms, with numerous large flowers in large and very dense heads occur in Asia Minor (Taurus, Kotschy! 357; Tmolus, Balansa! 414; Smyrna, Balansa! 412; Bithynia, Thirke!), in Greece (Taygetus! Parnassus! Thracia!), and in Piedmont (Herb. Link! Reichenbach fil.!). The plants from the southwest seem to be a little smaller; Spain (Willkomm! 263 & 246; Bourgeau! 331 & 1299; Ph. Schimper!). Several specimens from the Canary Islands belong rather to this than to *C. Episonchum*. In the East this species has been found in Egypt (Fischer!), in Syria (Kotschy! 104), in Persia (Kotschy! 580, a.), and in the Himalaya regions (Hiigel! Stocks! Hooker & Thomson!). The northern Asiatic form, which I had formerly distinguished under the name of [466 (16)] *C. cupulata*, occurs in the Caucasus, the Altai, and, as it seems, throughout Siberia (Ledebour! Godet! Becker! Karelin! 1721, etc.); flowers smaller in dense but small heads; calyx large, loose, almost entire, with broad and short lobes; scales comparatively large and incurved.

Var. *β.* SCHIRAZIANA, *C. Schiraziana*, Boissier! Diag. Or. I. 9, 86, has loose and few-flowered heads, rather membranaceous flowers, with the lobes of the deeply divided calyx and the laciniæ long and acute. The specimens examined by me, the same that Boissier described, were collected in Persia by Kotschy! and distributed under 118 and 318. In some the laciniæ are larger, in others shorter; scales larger and entire; or smaller, truncate and even bifid. — Link gathered a specimen of this form in Portugal on *Ulex nanus*, which has even longer lobes and a more deeply divided calyx than the Persian plant.

Var. *γ.* WEBBII. *C. Episonchum*, Webb Phyt. Canar. III. p. 36, t. 141. *C. Epiplocamum*, Webb! in Pl. Bourgeau, 1430. — This, together with *C. calycina*, Webb, another form of this species, seems to be the only native *Cuscuta* of the Canary Islands, though the Herbaria show the names of *C. Europæa* and *C. Epithymum* from thence; *C. Epilinum* has been introduced there. It has been collected by Webb! Bourgeau! 18, 426, 459, 1430; De la Perraudière! Bolle! and others. I have seen the same form from Portugal, Deakin! Welwitsch! 192. — In *C. Episonchum* the lobes of the calyx are not as completely united as in *C. Epiplocamum*.

Var. δ. TENORII. *C. planiflora*, Tenore! Syll. Fl. Neap. p. 128 and Flor. Neap. III. p. 250, t. 220, f. 3. — If I am not mistaken, Kunze (Flora, 1846, p. 655, in Plant. Willk. nro. 303) was the only botanist who recognized Tenore's plant; every other author has bestowed the name on some other forms of our plant or on some other species. *C. planiflora*, Koch! Germ. p. 570, and Reichenb. Fl. Germ. Exsicc. nro. 2069, are forms of *C. Epithymum*. — Tenore's plant is most common in Sicily and north Africa, extending to the Canary Islands, to Spain, southern France, Italy and the Mediterranean islands, to Greece and Egypt, and undoubtedly also to Asia Minor and Syria. It is one of the smallest *Cuscutæ*, the heads are compact, 2–3 lines in diameter, white or rose-colored. The turgidity of the almost cylindric lobes of the calyx and of the laciniæ is very distinct even in the dried specimen, and very striking in the fresh or soaked one. Flowers often less than 1 line in length; grains very rough, 0.3–0.4 lines in diameter. — This is *C. alba* of most authors, but not of Presl. *Succuta*, DesM. Et. 41 is a genus founded on an immature specimen of the same plant. *C. Epithymum*, Gussone! Flor. Inarim. p. 212, Cosson! in Plant. Bourgeau [467 (17)] and of many authors on plants of southern Europe. *C. Europæa*, Bové! in Hb. Mauritan. 149. *C. bracteosa*, Gaspar.! in Hb. *C. microcephala*, d'Escayrac! in Hb. *C. Godronii*, DesM.! l. c. 60, is a form with more acute lobes of calyx and corolla. *C. Sicula*, Tineo (*fide* spec. in the Hb. Cesati) is the same plant with lobes of the calyx a little broader. *C. calycina*, Webb! Phyt. Canar. III. p. 37, t. 152, has a larger calyx including almost entirely the corolla. *C. Canariensis*, Choisy! Mss. is the same thing. — It occurs in many published collections; besides those already mentioned it has been distributed by Bourgeau! 491, 1298, 1430, a. etc.; Aucher-Eloy! 1418; Huet de Pavillon! Palermo, etc.

Var. ε. PAPILLOSA is a peculiar form of the last subspecies, which thus far seems to have escaped observers; the whole flower is covered with semi-transparent papillæ; otherwise, I find no difference in specimens sent from Algiers to the Paris Museum by Balansa! But often the lobes are elongated and acute; so in the specimens from Tunis, Kralik! 410, Algiers, Cosson! Segovia, Hb. Gussone! A specimen from Arabia, Botta! in Hb. Mus. Paris., seems also to belong here. *C. globulosa*, Boiss. & Reut. is very closely allied to this form, and distinguished principally by the very short styles, and the globose corolla, the lobes of which cover the capsule; this form of the corolla does, however, occasionally also occur in specimens, which cannot be separated from *C. planiflora*.

5. C. PALÆSTINA, Boissier! Diag. Or. I. 11, 86. — This pretty little species is closely allied to the last, to which the author himself subsequently referred it; but it seems to hold its rank with a number of other species of this genus, the limits of which are so difficult to ascertain. Tournefort (Cor. 45) already distinguished it under the name of *C. Cretica*; it is also *C. micrantha*, Tineo! in Gussone Fl. Sic. Syn. II. 887, not Choisy; and *C. capillaris*, Reichenb. Pl. Crit. V. 64. *C. globularis*, Bert. Fl. it. VII. 625, is the same plant. — It grows on small mostly shrubby plants, on arid hills in the Mediterranean region; in Sicily, Tineo! Morea, Bory! Attica, Heldreich! Creta, Sieber! Raulin! and other Grecian islands, Lefêvre! etc.; Palestine, Boissier! Gaillardot! Blanche! — Heads only about 2 lines in diameter, flowers ½–1 line long, usually 4-, but often only 3-parted; only the central or primitive flower of the heads is often 5-parted; calyx comparatively large, with broad and short carinate lobes; top of laciniæ cucullate; scales rather large, broadly spatulate, incurved; styles somewhat longer than ovary.

§ 2. Styles as long as or shorter than ovary.

6. C. BREVISTYLA, A. Braun! in Pl. Schimp., and in Richard Tent. Fl. Abyss. II. 79, is perhaps too [468 (18)] nearly allied to *C. planiflora*, from some forms of which it is scarcely distinguished but by the short styles, which, in fruit, become divaricate. In the original Abyssinian specimens the lobes of the corolla are expanded, in some others they are closed over the capsule. The scales are short, thin and truncate or sometimes bilobed. — It has been found in Abyssinia, Schimper! III. 1486; on the Sinai, Botta! in Persia, Kotschy! 580; Affghanistan, Griffith! 686; Thibet, Hooker and Thomson! *C. elegans*, Noë! in Herb. 518 (not Boissier), from the Tigris, is the same plant.

Var. ? GLOBULOSA. *C. globulosa*, Boissier & Reuter! in sched.; Boiss. in Diag. Or. II. 3, 126. *C. Balansæ*, Boiss. & Reut. in sched. — This very pretty form at first sight looks very distinct; but Boissier himself already suggests the propriety of uniting it with "*C. alba*" (*planiflora*), and indeed its papillose flowers greatly resemble the var. *papillosa* described above; on the other hand it approaches *C. capitata*, but more in external appearance than in essential characters; the pretty red tinge of its flowers is occasionally found in both of these, and may be in some connection with the development of the papillæ. — The corolla closes over the capsule, giving the flower as well as the whole head an obtuse appearance; the scales in the original specimen are bilobed, in the other truncate; styles very short. — Mountain regions of Asia Minor: on the Tmolus, Balansa! 413; on the Taurus, the same! 707.

7. C. EUROPÆA, L. Sp. 180, excl. var. β. This well-known and well-characterized species offers none of the difficulties of all the other European *Cuscutæ*; the obconic calyx with its thick and fleshy and usually elongated base and thin and obtuse lobes, the thin corolla with obtuse laciniæ, the small and very thin bifid or truncate appressed scales, the large ovary and comparatively large capsule with short divaricate styles and bearing the dead corolla only on top (not enveloped in it) readily distinguish it; nor does it vary nearly as much as the others do; the flowers, however, are as often 5- as 4-parted.

This species has given cause to a good deal of discussion in regard to the presence or absence of scales; but though I have examined a number of specimens said to have no scales, among others the original var. *nefrens* of Sweden, I have never failed to discover that organ, though sometimes in a very defective state; I, therefore, cannot doubt that it is always present, but frequently so small and especially so very thin as to escape detection. In dry specimens, soaked or boiled, it adheres to the tube of the corolla so closely that it is scarcely possible to see or to separate it; but it is readily discovered and detached in the dry flower, if not too much mashed in pressing. The scales [469 (19)] are rarely rounded, oftener truncate, and toothed at the apex, most commonly bifid, and fimbriate or toothed, or consisting of two distinct lateral dentate or entire, often extremely small, lobes.

The capsule is commonly depressed, but a form with an elevated conic capsule, var. *conocarpa,* is not rare. Both often grow together, and cannot be distinguished otherwise.

Var. *Indica* has more crowded, smaller flowers, and perhaps a little longer styles. A specimen from Sarepta on *Alhagi Camelorum*, in the Herbarium of the St. Petersburg Botanical Garden, has still smaller flowers, but shows no other, to me, appreciable difference.

Var. *Viciæ* has often a more solid texture of the flower and fruit; which last does not open before full maturity, and may thus in herbaria sometimes seem to be indehiscent, while usually the capsules of dried specimens readily open long before they are quite ripe. A specimen from Hayti has larger flowers, fruit, and seed than any other I have seen.

C. Europæa inhabits the greater part of Europe and the mountains of Asia to the Himalaya. I have seen no specimens from Africa, or from Spain south of the Pyrenees, from Sicily or Greece. In Italy it grows near Rome! and Naples! also in Asia Minor! on the Caucasus! in Persia! Affghanistan! Thibet! and on the Himalaya! in general. Once only it seems to have been seen in America; Poiteau! in Herb. Neufchatel, gathered it on *Vicia* in Hayti, where it no doubt was introduced from Europe.

The following formidable list of synonyms shows how much this species has exercised botanists: —

C. major, Bauh. Pin. 219; DC. Fl. Fr. III. 644; DC.! Prod. IX. 452. *C. filiformis*, a, Lam. Fl. Fr. II. 307. *C. tetrandra*, Mœnch Meth. 461. *C. vulgaris*, Pers. Syn. I. 289. *C. tubulosa*, Presl! Del. 215. *C. Epithymum*, Thuil. Fl. Par. 85, not L. *C. Epicnidea*, Bernhardi Thur. Gartz. 1844, nro. 4. *C. halophyta*, Fries! N. Mant. I. 8. *C. halophila!* Sum. Veg. I. 191. *C. monogyna*, Schmidt, Fl. Bohem. and in some herbaria, not Vahl. *C. Ligustri*, Areschoug, Revis. Cusc. Suec. p. 17. *C. tetrasperma*, Jan! in sched. *C. hyalina*, Boiss.! in sched., not Roth. — *C. Segetum*, Rota in Giorn. Bot. Ital. II. 247, and *C. Viciæ*, Schultz, ap. DesM. are overgrown and often very destructive forms on fields of *Vicia*, *Medicago*, etc. — *C. Epitriphyllum*, Bernh. l. c. 1844, nro. 4; *C. Schkuhriana*, Pfeiff. Bot. Zeit. 1845, p. 673; *C. Europæa*, var. *nefrens* Fries! Sum. Veg. I. 191, and var. *vacua* Gren. and God. Fl. Fr. II. 504, are names given to a supposed form without scales. — Var. *Pontica*, C. Koch in Linnæa XIX. 19, I have not seen. *C. brachystyla*, C. Koch! in L. XXII. 747, is a form with often patulous laciniæ and with conic capsule. *C. capillaris*, [470 (20)] Edgeworth! Linn. Transact. XX. 68, is a more densely glomerate form from the Himalaya, with short laciniæ and very short bifid scales.

8. C. Kurdica, n. sp.: caulibus capillaceis; glomerulis parvis paucifloris bractea ovata acuminata suffultis; floribus arcte sessilibus plerumque 4-meris; calycis fere ad basin divisi lobis ovato-lanceolatis acutis crassiusculis tubum corollæ superantibus; laciniis ovato-lanceolatis erectis seu conniventibus (demum capsulæ arcte cinctæ adpressis) tubo fere longioribus; staminibus quam laciniæ multo brevioribus, antheris parvis subrotundis apiculatis filamento vix brevioribus; squamis basi tubi affixis parvis hyalinis tenuissimis truncatis; stylis ovario paulo, capsula depressa multo brevioribus.

On the Gara Mountain, Kurdistan, Kotschy! Pl. Al. Kurd. 388, b. under the name of *C. minor*, fide Choisy and *C. alpina*, Hohenacker, in sched.; Kurdistan, J. Brant! in Hb. Hooker. — In texture and habit resembling *C. Europæa*, but scales even yet thinner; flowers fewer, more closely sessile; lobes of calyx and corolla acute; corolla on the fruit globose, closely investing the whole capsule; styles very short and slender, not as much divaricate as in the allied species. — Flowers 1 line long; seeds large in proportion, 0.5–0.6 lines long.

9. C. Persica, Decaisne in Hb. Mus. Par.: caule filiformi; floribus sessilibus arcte glomeratis bractea ovata seu orbiculata suffultis; calycis campanulati lobis ovatis acutis corollæ tubum superantibus; laciniis tubo vix longioribus ovatis abrupte acuminatis sæpe papillosis, erectis demum patulis; staminibus brevibus; squamis spatulatis laciniato-fimbriatis faucem æquantibus incurvis; stylis brevibus subulatis vix ad medium stigmatosis in capsula tenuissima depressa corolla investita suberectis.

Ispahan, Persia, Aucher-Eloy! Herbier d'Orient in Hb. Mus. Paris, without number, apparently on some species of *Lactuca*. — A very distinct species, of which a single specimen only has come under my observation. The tough corolla totally invests and, as it would seem, supports the extremely thin capsule, just as in *C. capitata*, to which it is also allied by the subulate styles; scales larger than in any allied form, their fringes covering the top of the capsule. — Flowers 1½ lines long; seeds ½ line long, strongly reticulate.

10. C. Epilinum, Weihe, Archiv. d. Apoth. VIII. 54 (1824); DC. Prod. IX. 452. *C. densiflora*, Soyer-Willem. An. Soc. Linn. Paris, I. 26 (1822), only by name; description l. c., IV. 281 (1826). *C. major*, Koch and Ziz., Cat. Pal. 5. *C. vulgaris*, Presl, Cech. 56. *Epilinella cuscutoides*, Pfeiff. Bot. Zeit. Oct. 1845, p. 673; DesM. Et. 64. This well-known and very distinct species of the flax fields of Europe (Russia! Sweden! Germany! France! England! Ireland! Spain! Sicily!) extends into the Canary Islands (Webb! Finlay!) and Egypt (Kralik! Figari!), and has also been seen in the eastern parts of the United States! I have seen no specimens from Asia; but Roxburgh's *C. aggregata*, Fl. Ind. I. 447, "introduced into the Botanic Garden of Calcutta with flax from Bagdad," is most probably the same thing. [471 (21)]

The characters relied on for a generic separation of this species from *Cuscuta* are untenable, or are founded on mistake. The calyx is deeply 5-lobed, not 5-sepalled; the capsule is constructed exactly as in the allied species; the dissepiment is complete till, at maturity, the larger, lower, obcordate part separates from the upper substylar portion. The intrastylar aperture penetrates into the capsule only at full maturity, by a slit parallel to the dissepiment, and sometimes by a second transverse one. The stigma is at the flowering period almost twice as long as the style, and at base of the same thickness, slightly tapering to an obtuse point; only in fruit, when the style is shrivelled, the stigma has the appearance of being club-shaped.

The very short style, the shape of the thick stigma, and the structure of the stylar part of the dissepiment indicate a close alliance to the Asiatic species enumerated below, though all these have pedicelled, and not, like our species, closely sessile flowers. It is not improbable that it originally came from Asia or from Egypt.

Sect. 2. EPISTIGMA.

Styles none, or consisting of a very short knob on each half of the ovary; stigmata cylindric or subulate, usually of the length of the ovary. The capsule separates from the base only at complete maturity, in a ragged line, not by a regular joint; the opening is wide (*C. pedicellata*) or very small (*C. Arabica, C. pulchella*); the emarginate dissepiment remains in the base of the capsule, as in *Eucuscuta;* the withered corolla closely coats the capsule.

The distinctly pedicelled flowers are disposed in loose or compact umbelliform clusters, few-flowered or crowded, supported by a single bract.

The species belonging here are all Asiatic. *C. Arabica* extends into Egypt, where it seems to be the most common form.

This group constitutes the connecting link between *Eucuscuta* and *Callianche*, — another Asiatic form, in which the little remnants of the styles are united.

11. C. Kotschyana, Boiss. Diag. Or. I. 7, 29 (not *C. Kotschyi*, DesM.): well characterized by the large (2 lines long) flowers with a large, loose, cup-shaped calyx and acuminate laciniæ; fruit unknown. — Southern Persia, Kotschy! 749. I refer here a specimen from the Herbarium of the St. Petersburg Botanic Garden, collected in Armenia by Szovits, though the flowers are a little smaller and the calyx is rather more deeply divided. [472 (22)]

12. C. pulchella, n. sp.: umbellis laxis paucifloris bractea ovata acuminata suffultis; calycis carnosi lobis ovatis acutis corollæ tubum subæquantibus; laciniis tubo fere æquilongis ovatis acutis papillosis crenulatis erectis seu patulis; staminibus brevioribus, antheris ovatis filamenta subulata æquantibus; squamis angustis faucem attingentibus fimbriatis incurvis; stigmatibus ovarium globoso-ovatum apice subconicum æquantibus; capsula corolla connivente tota involuta apertura parva basilari demum dehiscente.

Var. β. Altaica: calyce profundius fisso; laciniis acutioribus; squamis minoribus sæpe bifidis.

Affghanistan, Griffith! 688–691, in Hb. Hooker, on *Alhagi*, *Peganum*, *Artemisia*, etc. β. Sarepta! originally from the Hb. of Pallas, and Altai, Sievers! both in the Herbarium of the Botanic Garden of St. Petersburg. Griffith's plant, which may be distinguished as α. *Affghana*, has beautifully bright red stems and flowers, the very fleshy calyx especially is bright colored; umbels 4–6-flowered, pedicels as long as calyx or as the whole flower; flower 1⅓ lines long; capsule opening late and with a very small circular aperture. — From *C. Kotschyana* it is distinguished by the much smaller flowers with longer pedicels, the deeply divided calyx, the ovate and not acuminate laciniæ. — The Altaic specimens may possibly constitute *C. Asiatica*, Pallas, but the specimen in Hb. H. B. Petropol., labelled thus by himself, belongs to *C. planiflora*, var. *approximata*.

13. C. pedicellata, Ledeb.! Fl. Altaic. I. 293, Icon. t. 234; DC. Prod. IX. 453, excl. syn. — The smallest flowered species of this section; flowers scarcely 1 line long, whitish, of very thin texture; scales small, truncate; styles almost united at base, separating in the ripe fruit; intrastylar aperture transverse to the dissepiment; top of thin capsule separating from the base with a very large opening, rather irregularly torn; more closely allied to the next than to both other species of this section, distinguished from it principally by the much smaller flowers and the wide opening of the ripe capsule. I have seen no other specimens but Ledebour's own, collected on the Altai, parasitic on some species of *Galium*. The other specimens referred to this species by authors do not belong here.

14. C. ARABICA, Fresenius! Pl. Ægypt. p. 165; Choisy! Cusc. 175, t. 1, f. 2, and DC. Prod. IX. 453; not of Wight. *Cassuta Arabica*, Des M. Et. 72. — A well-marked species, the most common one in [473 (23)] Egypt, and extending to the eastern shore of the Red Sea. It was collected in the former country by Bové! 354; Aucher-Eloy! 1418; S. Fischer! Kralik! and before all these by Lippi! — in Hb. Vaillant, where it is labelled as "Cuscuta sulphurei coloris Ægyptiaca, flore niveo," etc., — Arabia, on the Sinai, Rueppell! Schimper! nro. 140. — I cannot see how it is possible to ascribe to it capitate stigmata; nor is the capsule exactly baccate. This last error, however, is easily accounted for, as only the fully ripe capsule will separate from the base, and with quite a small opening. — The Sinai plant — the original *C. Arabica* — has shorter pedicels, denser glomerules, cordate-sagittate anthers, and larger, even incurved, scales. Var. *Ægyptiaca* is distinguished by its longer pedicels, looser umbel, rather orbicular anthers, and smaller, often bifid scales, which sometimes seem to be reduced to mere teeth. It may possibly be the luxuriant form, corresponding to *C. Trifolii*, and growing on cultivated plants.

SECT. 3. CLISTOCOCCA.

This group, represented by a single Asiatic species, is closely allied to *Epistigma*, but distinguished from it and all its other allies by the really baccate capsule, which at maturity separates from the persistent calyx, entirely covered by the closely enveloping corolla. The styles are subulate, much thicker at base, usually longer than the thin and pointed stigma. Flowers sessile, densely clustered.

15. C. CAPITATA, Roxb. Fl. Ind. I. 448. *C. rosea*, Jacquemont! in Hb. — Roxburgh's description, as far as it goes, agrees well enough with the species I take for it, which is, so far as I know, the only papillate Cuscuta in India; but it seems to be far from common there. It is, on the contrary, confined to the mountain districts, and to an elevation of from 6,000 to 12,000 feet. — The lanceolate lobes of the deeply slit calyx and corolla are covered with hemispherical or subcylindric papillæ, consisting of numerous very minute cells; scales in the lower part of the tube, not reaching to the middle, rounded or bilobed, dentate; styles as long as ovary, much shorter than capsule; capsule very thin and fragile, but strengthened by the dry corolla forming a tough coating over it; intrastylar aperture large. — Flowers over $1\frac{1}{2}$ lines long, often rose-colored; seed oval, 0.6 lines long.

India "in great abundance on *Crotalaria juncea*," Roxburgh; on the Himalaya, on some *Artemisia*, Jacquemont! 1550; on *Thymus*, 7,000 to 10,000 feet high, Thomson! in Kumaun, 12,000 feet high, Strachney and Winterbottom! nro. 3, in part (in some herbaria the Indian form of *C. Europæa* is preserved under this [474 (24)] number).

SECT. 4. PACHYSTIGMA.

Stigmata cylindric or oblong, obtuse, thicker than the filiform styles. Capsules bursting transversely, late, and not by a proper joint. Seeds compressed, indistinctly triangular, obliquely truncate at base, with a very short perpendicular or slightly oblique hilum.

Flowers pedicelled, disposed in a loose fascicled inflorescence; pedicels usually supported by bracts, only the latest ones naked. Corolla remaining on the top, or, in *C. Africana*, at the base of the capsule.

The three species of this group inhabit southern Africa, and are usually parasitic on evergreen shrubs. The form of the stigma is intermediate between that of *Eucuscuta* and of *Grammica*, and the inflorescence is similar to that of the latter.

16. C. ANGULATA, n. sp.: caulibus filiformibus; bracteis lineari-lanceolatis; pedicellis capillaceis flore longioribus (ultimis brevioribus) ramosis laxe fasciculatis; calycis profunde 5-partiti ad commissuras alato-angulati lobis late ovatis obtusis tubum corollæ late campanulatum superantibus; laciniis corollæ ovatis obtusis demum patulis stamina æquantibus; antheris obtusis basi profunde cordatis filamento subulato vix brevioribus; squamis ovatis fimbriatis tubum fere excedentibus incurvis; pistillis ovario parvo depresso-globoso bis terve longioribus tubum excedentibus, stigmatibus cylindricis seu subclavatis stylo ipso brevioribus. — *C. Africana*, Choisy! Cusc. 176, and DC. Prod. IX. 454, pro parte, *fide* spec. in Hb. De Cand. et cit. nec descript. *C. Africana, c.* Drege! in sched.

Cape of Good Hope, Dutuitskloof, 3,000 feet high, on *Staavia*, Drege! Mund and Maire! Harvey! in Hb. Hooker; Roxburgh! in Hb. Lambert, now Delessert. — The broad and short flowers, with broadly oval and obtuse lobes, and the 5-angled, or rather winged calyx, distinguish this species at first sight from both its allies. Choisy has confounded it with his *C. Africana*, as not only his reference to Drege's specimen but also his own label to this same specimen in De Candolle's authentic herbarium prove. — Flowers about $1\frac{1}{4}$–$1\frac{1}{2}$ lines long, $1\frac{3}{4}$ wide when fully expanded; styles usually longer than stigmata, only in very young flowers of the same length. Fruit and seed not seen.

17. C. NITIDA, E. Meyer! in sched.; Choisy! Cusc. 177, t. 2, f. 1, and DC. Prod. IX. 454. — Well distinguished by the broad and acute lobes of the calyx, the narrowly lanceolate acute laciniæ, and the stigmata, which usually are much longer than the styles, rarely of the same length; stamens half as long as laciniæ; [475 (25)] incurved scales as long as, or sometimes longer, than tube; capsule irregularly circumscissile.

This is *C. Africana, a.* Drege! *C. Africana,* Ecklon & Zeyher! 20, 77, 11, and 21, 1, 11. *C. Burmanni,* Choisy! Cusc. 177, and DC. Prod. IX. 454, is the same plant, as I have satisfied myself by a careful examination of the original specimen in Hb. Delessert. This specimen is further interesting as it bears the inscription "*C. Americana,*" it would seem, in Thunberg's handwriting. This may therefore be the original plant, which Thunberg first took for Linnæus' *C. Americana,* and afterwards named *C. Africana,* so that *C. nitida* would be the true Thunbergian *Africana;* but even if this be so, it will be better to leave the nomenclature as at present established, especially as quite probably Thunberg confounded both species. Another fact bearing on this question is, that in Jussieu's Herb., now in the Museum of the Jardin des Plantes, a specimen of *C. Chinensis* is preserved, labelled "*C. Americana, Thunb. C. B. Sp. Thunberg ded.*" So it seems that at one time Thunberg himself took *C. Chinensis* for his *Americana;* but as, so far as known, this plant does not occur at the Cape, it is quite possible that he brought this specimen from India or China, and confounded all those plants under one name. He does not mention *C. Chinensis* or any other *Cuscuta* from those regions.

C. nitida seems to be one of the commonest species at the Cape of Good Hope, and has been collected there by almost every botanist. Dr. R. C. Alexander communicated a specimen with firmer red stems; some of Drege's specimens exhibit a granulated, somewhat scabrous, calyx.

18. C. Africana, Thunberg? Fl. Cap. 568 and Phyt. Bl. 17; Choisy! Cusc. 176 and DC. Prod. IX. 454 pro parte. — I have above stated my doubts about the identity of Thunberg's plant, and my reasons, nevertheless, for retaining his name for this species. The older botanists also seem to acknowledge this for *C. Africana,* as I find a specimen thus labelled in Willdenow's Herb. nro. 3161. Choisy's description entirely refers to this plant, though one of the specimens he cites belongs to *C. angulata.*

It is well characterized by the very loose inflorescence, the long pedicels, the capillary styles, which are much longer (often more than twice as long) than the oblong and thick divergent stigmata; calyx short, lobes broad, obtusish, verrucose, imbricate; laciniæ linear-oblong, obtusish, involute at the margin and at tip, erect or spreading; scales large, often longer than the tube, incurved; capsules, in the only specimen in which I could find any, almost baccate, or opening very late, with the corolla persistent at base, mostly with a single globose [476 (26)] seed, 0.7 lines long; flower 1–1½ lines long. — *C. Americana,* Thunb. Prod. 32, not of Linnæus, is the same as his later *C. Africana.* — Our plant was collected by Drege! 7010, and labelled by him *C. Africana, d;* it is Ecklon and Zeyher's! 22, 70, 10. *Schrebera schinoides,* L. Sp. 1662, is — as the figure in Nov. Act. Ups. I. t. 5, f. 1, shows — this species parasitic on *Myrica Africana. C. fusiformis,* Willd. Rel. in R. and S. VI. 209, referred here by Choisy, a misprint for *C. funiformis,* as spelt in Willd. Herb. nro. 3156, is not a *Cuscuta,* but a *Cassyta* from the Cape, as Schlechtendal has long since stated.

C. Capensis, Choisy! Cusc. 175, t. 1, f. 4, and DC. Prod. IX. 454, is a large form of this species; flowers 2¼–2¾ lines long; calyx smoother and shorter; laciniæ longer, somewhat acutish; scales smaller. It bears the same relation to *C. Africana* that *C. Trifolii* does to *C. Epithymum.* — Drege! 7833, Dr. Thom! Dr. Alexander!

Sect. 5. EUGRAMMICA.

Styles of unequal length, subulate or cylindric; stigmata capitate; capsule bursting transversely more or less regularly, in *C. Jalapensis* regularly circumscissile; seeds often only one or two in each capsule, rounded or flattened, truncate at base, or hooked; hilum forming a transverse or oblique, rarely a perpendicular line, often very short, or reduced to a point.

The inflorescence is quite variable, forming few-flowered loose cymes, or compound racemose or umbelliform cymes with pedicelled flowers, or compact clusters with subsessile flowers, with bracts at the base of each, or at least the primary pedicels or flowers. The corolla remains at the base or on the top of the capsule, or completely envelops it.

Most species of this section inhabit South America, the West Indies, and Mexico. One (*C. umbellata*) extends into the southwestern parts of the United States, and two (*C. odontolepis* and *C. applanata*) are peculiar to that region; two others are natives of Asia, one extending to New Holland, the other to eastern Africa.

§ 1. Subulatæ.

Styles thick and short, subulate from a broad base; flowers mostly large and of a firm texture; scales wanting in one (the first) species; corolla enveloping the whole or the greater part of the ripe capsule in all but the first; capsule opening readily by more or less regular circumscission.

* Lobes of calyx orbicular, imbricate. [477 (27)]

19. C. grandiflora, HBK.! N. Gen. Sp. III. 123, t. 213; DC. Prod. IX. 457; not Wallich Cat. — This beautiful and striking species is so well described by Kunth that it is not necessary to add a single line. He already mentions (as he also does in regard to *C. Popayanensis*) the circumscissile opening of the capsule, ignored

by later writers. The *raceme* of flowers on the left side of his otherwise very correct figure is imaginary, as the inflorescence is a loose few-flowered cyme. The flowers have a diameter of full 4 lines, and are 2½–3 lines high; the subulate filaments are inserted a little below the throat; no trace of scales visible; styles and capsule scabrous or verrucose; dry corolla at base of capsule; ripe seeds only 0.8 lines in diameter, almost globose, very rough; hilum a mere dot.

This species is peculiar to the Andes about the Equator; New Granada, Humboldt! Purdie! Goudot! Peru, Haenke! Cl. Gay! Weddell! 4768; Bolivia, Weddell! 4518; Chili, Edmonston!

20. C. ODORATA, Ruiz & Pavon! Fl. Peruv. I. 69, t. 105, f. a., not Choisy nor Pœppig. *C. intermedia*, Choisy! Cusc. 179, t. 2, f. 3, and DC. Prod. IX. 455; Gay, Fl. Chil. IV. 447. — After examining the original specimen in Hb. Ruiz, now in the Royal Herbarium at Berlin, and the almost identical one in Hb. Pavon, now in the possession of E. Boissier of Geneva, — which latter is the original for Choisy's description, — I can have no doubt about the identity of these plants. — Flowers 3 lines long, 3–4 lines in diameter, on very short pedicels, forming dense lateral clusters; laciniæ rather longer than the shallow tube; scales very large, deeply fringed; corolla surrounding and partly covering the irregularly circumscissile capsule; seeds triangular-rounded, nearly 1 line long. — In the Flora Peruviana the capsule is already figured as circumscissile; but the whole figure, especially the details, are not very correct, and rather calculated to mislead.

Peru, Ruiz! Pavon! A. Matthews! 486; Weddell! 4693; Ecuador, Seemann! 852; Chili, Cl. Gay! 38 & 815. — In Weddell's specimen the tube is more cylindrical and longer and the lobes rather shorter, uniting this species with

Var. β.? BOTRYOIDES, from southern Brazil, Lobb! 49, in the Kew Herbarium. — Dense clusters of flowers, arranged in long pendulous bunches resembling grapes; tube deeply campanulate, almost cylindric, nearly twice as long as the broad, rounded laciniæ; corolla enveloping the widely gaping capsule, the styles of which are shorter and thicker than in *C. odorata;* stylar portion of dissepiment broad and jagged. — Apparently intermediate between this and *C. Chilensis*, and perhaps specifically distinct. [478 (28)]

[20ᵇ. C. GLOBIFLORA, n. sp.: caulibus filiformibus crassiusculis; glomerulis paucifloris compactis; floribus subsessilibus bractea una alterave orbiculata concava suffultis; calycis fere ad basin fissi lobis orbiculatis imbricatis margine tenuissimo ciliolatis tubum corollæ ventricosum globosum subæquantibus; laciniis ovato-orbiculatis crenulatis imbricatis erectis seu conniventibus tubo brevioribus; antheris ovatis filamento brevissimo longioribus; squamis magnis ovatis breve fimbriatis faucem pene attingentibus; stylis ovario globoso æquilongis. [520 (70)]

Cuzco, Bolivia, at an elevation of 11–12,000 feet, Pentland! in Hb. Hooker. — Glomerules in the single specimen seen 6–7 lines in diameter, consisting of 2–5 flowers; flowers with the thick calyx and the surrounding bracts almost globose, 3–3½ lines long, a little less in diameter; corolla really ventricose or urceolate; ovary globose or even depressed; I could not ascertain whether the styles become subulate; stigmas small and slightly conic; in the dried state the young capsule seems to be circumscissile even long before maturity; corolla apparently covering the capsule. Evidently closely allied with *C. odorata*, to which in habit and inflorescence it bears a great resemblance.]

21. C. JALAPENSIS, Schlechtendal! Linnæa, VIII. p. 515. — Though well and carefully described, and published as early as 1833, this well-marked species has been overlooked by later writers. It is similar to the last, but much smaller; flowers, though on short pedicels, much less crowded. Its most striking character consists in the regularly circumscissile conic capsule, with shorter very strongly subulate styles, whence Schlechtendal not inappropriately calls it "bicornis." [478 (28)]

Peculiar to Mexico; Jalapa, Schiede! 152; Linden! 308; near Mexico, Graham! 250; Bustamente! 83; Oaxaca, Galeotti! 4413.

22. C. CHILENSIS, Ker, Bot. Reg. VII. f. 603; Choisy! in DC. Prod. IX. 455; Gay! Fl. Chil. IV. 446. *C. odorata*, Pœppig! in Hb. 90. — A common plant in Chili, whence almost every collector sends it; well characterized by the densely clustered almost sessile flowers, cylindric tube, large, linear, almost sessile anthers, and short deeply fringed scales; styles as long as the irregularly circumscissile capsule, even in fruit scarcely reaching to the throat of the tube; seed oval, triangular, compressed, 0.7–0.8 lines long, with a small umbilicus marked with radiating lines, which centre in the small round hilum.

[*C. odorata*, Choisy! Cusc. 180, t. 2, f. 4; DC. Prod. IX. 456; Gay! Fl. Chil. IV. 447, not Ruiz & Pavon, according to the description and figure of Choisy and the authentic specimens in Hb. De Candolle, does not essentially differ. The specimens of Gay, 816 and 817, and of Bertero, 940, have a thinner, more membranaceous texture than the ordinary *C. Chilensis*, but Gaudichaud's specimen is absolutely identical with it.] [520 (70)]

* * Lobes of calyx acute. [478 (28)]

23. C. FŒTIDA, HBK.! N. Gen. Sp. III. 122; DC. Prod. IX. 460, not Hook. & Arn. Bot. Beechy. *C. pycnantha*, Bentham! Pl. Hartw. p. 226. *C. corymbosa*, Jussieu! in Hb. Juss. — Clusters large and

compact, ½–1 inch in diameter; flowers fully 3 lines long; lobes of calyx and of cylindrical corolla very acute or acuminate; stamens very short; scales much shorter than the tube, in Humboldt's specimen broadly oval, in others narrow; styles strongly subulate, as long as capsule; seeds 0.6 lines long.

Quito, 8,000 to 10,000 feet high, Humboldt! Couthouy! Peru, Jos. Jussieu! Ecuador, Seemann! Columbia, Hartweg! 1238.

24. C. ACUTILOBA, n. sp.: caule filiformi; cymis laxis paucifloris; pedicellis brevibus bracteis lanceolatis acuminatis suffultis; calycis campanulati lobis triangulatis acutis tubum corollæ profunde campanulatum æquantibus; laciniis lanceolatis acutissimis erectis demum reflexis tubum æquantibus seu paulo longioribus; staminibus multo brevioribus, filamentis anthera ovata brevioribus; squamis spatulatis fimbriatis fauceu fere æquantibus; stylis e basi crassa subulatis ovarium æquantibus inclusis; capsula corolla marcescente tota involuta [479 (29)] irregulariter circumscissa.

At the Bridge of Obragilla, Peru, Alex. Matthews! 661 in Hb. Hooker. — Very nearly allied to the last, distinguished by the loose, few-flowered inflorescence, the small and apparently deep purple (a color not noticed in any other species) flowers, the triangular, not imbricate, lobes, the short tube of the corolla, and the still more broadly subulate styles. By the styles it is distinguished from *C. umbellata*, which it otherwise considerably resembles. — Flowers 1¼–1½ lines long; single seeds globose.

§ 2. Obtusilobæ.

Styles slender, usually capillary; flowers large or small, usually thin and membranaceous; lobes of calyx obtuse in all but the last species; corolla short in the three first, long and cylindric with short laciniæ in the four last species; scales absent in one (the last) species; styles short in the first, very long in the four last species; capsule opening late, and mostly irregularly; dead corolla enveloping the capsule except in the first species.

* Flowers short.

25. C. APPLANATA, n. sp.: caule filiformi; floribus breviter pedicellatis vel subsessilibus in glomerulos densos sæpe continuos congestis; calycis campanulati tenuis lobis ovatis obtusis tubum corollæ late campanulatum depressum æquantibus; laciniis ovatis obtusis patulis demum reflexis tubo æquilongis; antheris oblongis filamenta brevia subulata æquantibus; squamis maximis crispato-laciniatis faucem excedentibus supra ovarium magnum depressum incurvis; stylis capillaribus ovarium æquantibus seu excedentibus e fauce exsertis; capsula depressa corolla marcescente involuta irregulariter circumscissa.

In Arizona Territory, south of the Gila River, Chs. Wright! Mex. Bound. Survey, 1623 (541), on some *Nyctaginea*, and 1625 (685) on *Ambrosia;* fl. Sept. — Glomerules 3–4 lines in diameter, often strung together like beads; 6–12 flowers in each glomerule, 1–1¼ lines long, of thin texture and white color, on short branched pedicels, supported by small obtuse bracts; capsule 1 line in diameter, half as much in height, with a very small intrastylar opening; seeds ½ line long, oval, strongly verrucose-reticulate, with a short and broad oblique or perpendicular hilum. In aspect this plant resembles somewhat *C. arvensis*, but is abundantly distinct from this and any other species.

26. C. CHINENSIS, Lamarck! Enc. II. 229; Choisy! Cusc. 183, t. 3, f. 4, and DC. Prod. IX. 457. *C. sulcata*, Roxb. Ind. I. 447; Wallich! Cat. 1320². *C. capillaris*, Wall.! Cat. 1321. *C. Americana*, Thunberg! in Hb. Jussieu. *Grammica aphylla*, Loureiro! Cochin. 171; ed. Willd. I. 212. — A common plant, as it [480 (30)] appears, of the tropical regions of Asia and the islands southward, especially Ceylon, extending into Candahar (Griffith! 685) and China (in Hb. H. B. Petropol.! as "*C. fimbriata*, Bunge," which name seems to be apocryphal), characterized by the strongly carinate rather than sulcate lobes of the thereby 5-angled calyx, with five secondary angles at the commissures; scales rather large, deeply laciniate, and not, as Choisy describes and figures them, short and adnate below the throat; styles slender; capsule very thin, enveloped and covered by the corolla, opening at base rather irregularly and late, and therefore often termed "baccate;" Loureiro himself describes the fruit of his genus *Grammica* as a "bacca," though his original specimen in the Hb. of the British Museum shows the circumscissile capsule. Flowers 1–1¼ lines long; seeds 0.5–0.7 lines long, oval; hilum oblique or usually nearly perpendicular. — Lamarck's original specimen, accidentally raised in the Jardin des Plantes of Paris, in 1784, with seeds supposed to have come from China, is preserved in Hb. Jussieu in Mus. Paris.

C. hyalina, Wight, Ic. 1372; Wallich! Cat. 1320¹, not Roth, is a form of this species, with bifid and rather small scales.

A form from the island of Nassibé, near Madagascar, Boivin! in Hb. Vindobon., has also bifid scales, but is distinguished from all other varieties by the capsule being exsert above the corolla, and by the large intrastylar aperture.

Var. β. CARINATA, *C. carinata*, R. Brown! Prod. N. Holl. I. 491, from the tropical parts of New Holland, is the same species, with more strongly carinate and more obtuse lobes of the calyx, more obtuse laciniæ, and almost globose anthers.

Var. γ. CILIARIS, *C. ciliaris*, Hohenacker! in Pl. Kotschy, Boissier! Diag. Or. II. 3, 129, is a stouter, larger-flowered northern form of the same plant, with shorter and stouter styles; scales spatulate, or sometimes in the same flower bifid, less deeply and finely fimbriate; flowers $1\frac{3}{4}$–$2\frac{1}{4}$ lines long. — Mossul, Kotschy! 431; Kurdistan, Grant! in Hb. Torrey. — The specimen of Herb. Wight. propr.! 2408, is the same thing from India. The largest-flowered form is preserved in Hb. Mus. Paris, under the name of *C. exigua*, collected at the Selenga River, in Siberia, by Demidoff, a cotemporary of Pallas; lobes of calyx and corolla in this specimen more distinctly crenulate than in most other forms of the species.

27. C. TINCTORIA, Martius! in Herb.: caulibus filiformibus subfunicularibus; floribus globosis pedicellatis in glomerulos laxos umbelliformes congestis; calycis cupulati lobis orbiculatis imbricatis tubum corollæ campanulatum æquantibus; laciniis tubo æquilongis ovatis obtusis basi imbricatis erectis seu demum [481 (31)] patulis reflexive; antheris ovatis filamento subulato brevissimo plerumque longioribus; squamis late-ovatis fimbriato-laceris tubum æquantibus seu paulo excedentibus incurvis; stylis filiformibus ovario depresso longioribus fere exsertis; capsula irregulariter circumscissa corolla marcescente involuta tectaque.

Mexico, usually, as it seems, on trees; Oaxaca on *Schinus molle*, Karwinski! who relates that the natives use it under the name of "Zaca-tlascalli" as a yellow dye, — and, indeed, the dried specimens tinge water, paper, etc., deep yellow, which I notice also in some other South American *Cuscutæ;* San Luis Potosi, on the same species of tree, Dr. Gregg! in full bloom in December. — Flowers 2–$2\frac{1}{2}$ lines long, in loose clusters, of six lines in diameter, which are gathered into long racemes; intrastylar aperture small; seed compressed, rounded, 0.6 lines in diameter. — The slender style and the shape of the capsule distinguish this species from the similar *C. Jalapensis*, the short flower and short style from *C. floribunda*, the circumscissile capsule and larger flower from *C. Gronovii*, and the short filaments from all of them. A specimen, however, in the Hb. H. Bot. of St. Petersburg, collected by Karwinski on an oak "between Victoria and the Rio Blanco," has filaments as long as the anthers.

* * Flowers elongated.

28. C. FLORIBUNDA, HBK.! N. Gen. Sp. III. 123; DC. Prod. IX. 459. — The only specimens of this plant known to me, gathered by Bonpland! at the Bridge of Istla, in western Mexico, 3,000 feet high, are preserved in the Royal Hb. at Berlin and in Hb. Willdenow, nro. 3159[3]. They are in rather poor condition, and in ripe fruit only. Enough is left, however, to show that the plant is nearly allied to *C. Popayanensis*, as Kunth already states, but well distinguished by the short and thick, orbicular, deeply divided, broadly imbricate lobes of the calyx; the deeply divided corolla; the oblong linear (obtuse, not acute, as Kunth has it) laciniæ nearly equalling in length the cylindric tube; large oval scales deeply fimbriate-laciniate, reaching to the throat; styles twice as long as capsule, slender, long exsert in fruit; stylar portion of dissepiment elongated, almost reaching the base of the capsule; seed 0.8 lines long, narrow, triangular, and very rough. Flower with the lobes 3, or, when these are reflexed, 2 lines long. From *C. tinctoria*, to which it is even more closely allied, it may be distinguished by the long tube, the narrow laciniæ, the long styles, and the long and narrow seeds.

29. C. AMERICANA, L. Sp. 180 pro parte; Jacq. Am. 30, p. 17; Choisy! Cusc. 186, t. 4, f. 4; [482 (32)] DC. Prod.IX. 459. *C. graveolens*, HBK.! N. Gen. Sp. III. 122. — This is the most common species of the West Indian Islands, parasitic mostly on shrubs and trees. It extends to the Pacific coast of Mexico, and on the Atlantic coast of South America from Venezuela to Brazil; rarely, as it would seem, leaving the neighborhood of the sea-coast, though Weddell found it in the province of Goyaz, in central Brazil. — Well characterized by the small, cylindric corolla, with short, very obtuse, almost always erect laciniæ slightly protruding over, or sometimes almost enclosed by, the wide and deep cupulate calyx; scales short, attached to the middle of the corolla, and usually not reaching to its throat; styles very slender, mostly much longer than the very small globose ovary, exsert only in fruit; capsule late and irregularly circumscissile; stylar portion of dissepiment reaching nearly to the base of the capsule; seeds mostly solitary, filling the whole capsule, roundish, somewhat compressed; hilum forming a very short line, almost a point.

The ordinary *C. Americana* has flowers $1\frac{1}{4}$–$1\frac{1}{2}$ lines in length; a thin, when dry, membranaceous and very wide calyx; scales either truncate, sometimes almost bilobed, slightly dentate, or somewhat fimbriate; styles usually included during flowering, more or less exsert in fruit. — Martinique, Sieber! 91; Hayti, Poiteau! Ehrenberg! Antigua, Wullschlægel! with larger flowers; Portorico, Bertero! St. Thomas, Ridlé! Holton! Yucatan, Linden! Venezuela, Humboldt! Karsten! Fendler! 2069; Surinam, Hb. Ac. Phil.! Brazil, Gardner! 1775; Blanchet! 736; Goyaz, Weddell! 2208.

Different varieties may be distinguished according to the length of the pedicels, size of flower, texture of calyx, shape of scales, and length of styles; but they run into one another so that I, with twenty-five or thirty specimens from the whole range of the species before me, am unable to limit even these varieties. The smallest form is *C. congesta*, Bentham! Bot. Sulph. 138, from Acapulco: flowers crowded; scarcely more than 1 line long; scales triangular, almost entire; styles slender. A similar plant was collected by Dr. Gregg at Mazatlan; flowers rather

more slender, calyx narrower than in any other form, and more distinctly 5-angled (angles corresponding to the commissures); scales and styles as in the other. *C. leiolepis*, Miquel! Linnæa, XVIII. 247, is the same thing from the orange hedges in Surinam, but with shorter styles than any other form of this species examined by me. *C. Surinamensis*, Schilling, de Lepra, pp. 60 and 200, t. 2, also seems to belong here. *C. campanulata*, Nuttall! mss. in Hb. Ac. Phil. from the West Indies, has the scales of this, but otherwise is identical with the ordinary form.

Another form has a thicker, more coriaceous calyx, usually larger flowers ($1\frac{1}{2}$–$2\frac{1}{4}$ lines long), larger [483 (33)] more deeply fimbriate scales, often exsert styles, and sometimes 2-seeded capsules. This is *C. spectabilis*, Choisy! Cusc. 187, t. 5, f. 1; DC. Prod. IX. 459, from Bahia, Salzmann! 351; Blanchet! 85, and *C. globulosa*, Bentham! Bot. Sulph. 138, from Acapulco. The specimens from Surinam, Hostmann! 464, one of Poiteau's! from Hayti, and especially Linden! 1994, from Cuba, the largest of all, may be referred here.

C. Americana, L., and of most authors on the Flora of North America, comprises, besides this, several North American species, especially *C. Gronovii*, *C. arvensis*, and *C. compacta*. *C. Americana*, Thunb. is *C. Africana*.

30. C. CORYMBOSA, Ruiz & Pavon, as intended by the authors, is a rare form of a species which, under different names, is common throughout northern South America and Mexico. The species, as here proposed, is distinguished by the cupulate membranaceous calyx, with short and broad very obtuse lobes, loosely enclosing the lower part of the long cylindric tube of the corolla; laciniæ short, mostly very obtuse, erect or rarely spreading; anthers oval or orbicular-oval, sessile or on very short filaments; scales mostly long and narrow, attached for the greater part of their length, more or less fringed at the sides and apex, always considerably shorter than the tube, rarely quite small and indistinct; ovary small, globular or conic, with very long styles, which generally reach as high as the anthers, and often become exsert as the fruit ripens; capsule very small, often 1-seeded, always opening in its largest diameter, surrounded and covered by the base of the shrivelled corolla; stylar portion of dissepiment reaching nearly to the bottom of the capsule; hilum reduced to a point. Very closely allied to the last species, but readily distinguished by the larger flowers and the larger elongated and exsert corolla.

Var. *a.* GRANDIFLORA: flowers large, 3–4 lines long; anthers on very short filaments or sessile; scales long and narrow, almost entirely adnate, rarely bifid; styles reaching the anthers or shorter; ovary and capsule globose or rarely somewhat conic. *C. Popayanensis*, HBK.! N. Gen. Sp. III. 123; DC. Prod. IX. 460, of which Kunth already mentions the capsule as circumscissile, and speaks of the close alliance to *C. corymbosa*. *C. cymosa*, Willd.! rel. R. & Sch. VI. 205, founded on the same specimen. — New Granada, Humboldt! Columbia, Hartweg! 1237; Moritz! 489; Comitan, Mexico, Linden! 291; Caracas, Birchel! Gollmer! Venezuela, Fendler! 946; Peru, Dombey! in Hb. Mus. Paris, under the name of *C. corymbosa*.

The following forms do not seem sufficiently distinct from this: *C. patens*, Benth.! Bot. Sulph. 35, [484 (34)] from the Magdalen Bay, Lower California, has rather wider and a little shorter flowers and shorter styles, which reach only as high as the linear scales.

C. inclusa, Choisy! Cusc. 179, t. 2, f. 2; DC. Prod. IX. 455, from Mexico, Berlandier! 1103. — Similar to the last; styles even longer, but scarcely reaching the throat; anthers sessile. Choisy's figure shows long filaments, and his description speaks of "stamina basi corollæ affixa," etc., which is perfectly unintelligible. Choisy's figures are by no means reliable in the details; as is evident in examining, for example, the scales in his figures of *C. Arabica*, *Chinensis*, and others, the ovary of *C. Gronovii*, *Americana*, etc. This is one of the few *Cuscutæ* known to me where there is in the flower in full bloom a slight approach to the ventricose shape.

C. laxiflora, Benth.! Bot. Sulph. 138, from Acapulco, is the same plant, with a somewhat conic ovary and capsule, uniting this with the next form; flowers about 3 lines long, styles not exsert.

C. Popayanensis, Pœppig! Hb. is a variety of *C. micrantha*.

Var. *β.* STYLOSA. *C. stylosa*, Choisy! Cusc. 187, t. 5, f. 2; DC. Prod. IX. 459. — Flowers rarely more than 2 lines long, slender, with very short calyx; narrow cylindric corolla; short, narrow scales; filaments as long or shorter than anthers; styles reaching to the throat of the corolla or above it, often long exsert at maturity of fruit or before; ovary and capsule conic, or rather inversely pear-shaped. The length of the styles is variable, even in the original specimens quoted by Choisy; the shape of the capsule would be characteristic enough, if intermediate forms did not indicate a transition to var. *grandiflora*. — Found thus far only in Mexico: Andrieux! 73 and 214; Berlandier! 822; Hb. Jacquin! under the name of *C. Americana;* Ghiesbrecht! 186; Toluca, Karwinski! Zimapan, Galeotti! 1412; Jalapa, Linden! 308 in part.

In the Kew Herbarium I find a specimen sent by Botteri from the Orizaba, Mexico (nro. 949), which is this form with scarcely exsert styles, larger flowers (3 lines long), and acutish crenulate laciniæ.

Var. *γ.* MICROLEPIS. *C. corymbosa*, Ruiz & Pavon! Fl. Peruv. I. 69, t. 105, b., not Choisy Cusc. nor DC. Prod. — Flowers $1\frac{3}{4}$–2 lines long, as often 5- as 4-parted in the original specimens in Hb. Ruiz and in Hb. Pavon, both of which seem to be parts of one and the same specimen; calyx cupulate, with short obtuse lobes half as long as the corolla; laciniæ ovate, obtuse, nearly one third the length of the tube, erect or patulous; filaments as long as the

broadly ovate-cordate anthers ; scales reduced to very thin and small ovate membranes, with 4–7 or 8 ir- [485 (35)]
regular teeth inserted below the middle of the tube, perhaps sometimes entirely wanting; ovary slightly
conic, with styles scarcely reaching to the throat, just exsert in fruit. In the figure in the Flora Peruviana the cylindric corolla and the circumscissile capsule are correctly given. — Peru, on shrubs, and on *Medicago sativa,* Ruiz & Pavon! not found since.

It is well known that Choisy, l. c., and every author after him, myself included, took the *Cuscuta* — which twenty years ago made its appearance in different parts of Europe, in fields of *Medicago,* said to have been imported from Chili — for this species. The figure, as well as the original specimens, prove this to have been a mistake ; that plant is *C. racemosa,* Mart., as will be shown below. Whether the scales are ever really absent, or only very small and difficult to find, I cannot say. In eight or ten flowers which I carefully examined I could not always discover them, especially after soaking the flowers; unfortunately, the specimens are injured by too hard pressing. With the exception of the smaller flowers and indistinct scales, I find nothing to separate this from the other forms, which are more abundant and better developed, but had to yield their specific names to priority.

31. C. PRISMATICA, Pavon! mss.; Choisy! Cusc. 182, t. 3, f. 2; DC. Prod. IX. 457. — A very distinct species, and one of the few without any scales. Choisy's figure as well as description is not very correct. Bracts lanceolate acuminate; flowers subsessile, 3 lines long; calyx elongated, obconic, fleshy, deep red, 5-angled from the decurrent carinæ of the unequal, ovate, acute or cuspidate imbricate lobes; corolla almost cylindric, long exsert, externally granulated, laciniæ 4–6 times shorter than the tube, oblong, obtuse, somewhat involute at the margins, crenulate; anthers ovate-cordate, sessile ; ovary turbinate ; capillary styles shorter than the tube, much longer than the ovary. I have seen no fruit of this plant, but venture to class it here on account of its close affinity with the last species, from which, however, it is abundantly distinguished by all the characters above enumerated. The only specimens seen are from Guayaquil, Pavon! in Hb. Boissier, and Hænke! in Hb. Mus. Bohem. Pr.

§ 3. Leptolobæ.

Styles slender, usually capillary ; flowers rather small, membranaceous ; lobes of calyx and corolla acute, often acuminate, commonly narrow and elongated, as long or longer than the usually campanulate tube ; scales absent only in the last species; capsule surrounded or covered by the corolla, opening by irregular or rather regular circumscission.

32. C. ODONTOLEPIS, n. sp.: caulibus tenuiter filiformibus ; floribus breviter pedicellatis bracteatis [486 (36)]
in glomerulos laxiores demum decompositos crassos confertis ; calycis breviter campanulati profunde partiti
nitidi lobis ovato-triangulatis acutiusculis tubum corollæ profunde campanulatum subæquantibus ; laciniis ovato-lanceolatis acutis demum patulis reflexisve tubo paulo brevioribus ; antheris ovatis filamenta subulata brevia æquantibus ; squamis late ovatis e tubi basi oriundis ad medium adnatis faucem fere attingentibus versus apicem grosse dentatis ; stylis capillaceis ovario depresso-globoso multoties longioribus e fauce paulo exsertis demum elongatis ; capsula corollæ rudimentis calyptrata rite circumscissa.

Near a deserted Rancho, on a rocky hill-side in Arizona, parasitic on *Amarantus ;* fl. Sept., Chs. Wright! 1624 (529). — "Whole plant very white." Clusters of the large and showy flowers at last crowded, more than 1 inch in diameter ; flowers 2½ lines long, on pedicels as long or shorter than the calyx, which in one specimen covers the tube, and in another is shorter; scales large, irregularly toothed towards the apex only; capsule globose ; readily opening towards the base by a small circular aperture ; stylar portion of dissepiment scarcely half as long as capsule ; seeds usually all four developed ; oval, about ½ line long, verrucose, with a small linear vertical or transverse hilum. — In general aspect, as well as in some particulars, this species very closely approaches to *C. corymbosa,* but seems to be well distinguished by the characters given, especially the deeply divided corolla, its acute laciniæ, the broad dentate scales, the small basal opening of the capsule, the seed, etc. It is not impossible, however, that intermediate forms may yet be discovered, which will oblige a future monographer to unite them. On the other hand, the similarity to *C. subinclusa* — a Californian species, which has decidedly baccate capsules — is so great that one might be induced to doubt the diagnostic importance of this character.

33. C. XANTHOCHORTOS, Martius! in Hb.: caulibus filiformibus ; glomerulis sessilibus globosis multifloris ; bracteis ovatis ; pedicellis ramosis, ultimis calyce campanulato profunde fisso brevioribus ; lobis ovatis obtusis basi imbricatis margine sæpe reflexis tubum corollæ late campanulatum æquantibus seu superantibus ; laciniis lanceolatis elongatis acutiusculis tubo multo longioribus patulis reflexisve basi imbricatis ; antheris oblongis filamento subulato subbrevioribus ; squamis late ovatis fimbriato-laceris faucem excedentibus ; stylis capillaceis demum divaricatis ovario ovato multo longioribus ; capsula conica corollæ rudimento involuta basi regulariter circumscissa.

Porto Alegre, Rio Grande de San Pedro, Brazil, Father Joannes de Sta. Barbara! in Hb. Martius. —
The specimen consists of an intricate mass of deep yellow stems, with few heads of flowers just develop- [487 (37)]
ing; a few half-ripe but already circumscissile fruits were seen. Flowers 1½–2 lines long. This plant
seems to be nearly allied to *C. umbellata,* but is distinguished by more compact heads, larger flowers, broad and

imbricate obtusish lobes, etc. The laciniæ of the corolla, always elongated, are in some flowers acutish, in others almost obtuse.

34. C. PARTITA, Choisy! Cusc. 188, t. 5, f. 3; DC. Prod. IX. 460. — Brazil, Blanchet! 3047; Gardner! 2684; westward to Bolivia, Weddell! 3483 and 3611; and northward to Venezuela, Maracaibo, Karsten! and Curaçao, Friedrichsthal! 375, b; usually low, on herbaceous plants, *Leguminosæ*, *Malvaceæ*, *Euphorbiaceæ*, etc. — Cymes compound, paniculate; bracts ovate-lanceolate, often crenate; flowers small, usually less than 1 line long, more or less glandulous, and filled with coloring matter, deep-red when dry, like *C. miniata;* calyx divided almost to the base, lobes lanceolate acute; lobes of corolla of same shape, at length reflexed with the points incurved; tube of corolla at last ventricose, enveloping the capsule, divided by grooves which correspond to the stamens into five separate externally convex compartments, as it were; scales as long as the tube or shorter, deeply fringed; capillary styles much longer than the small globose ovary, subexsert, sometimes recurved on the fruit; capsule very thin, hyaline, irregularly circumscissile with a wide opening; seeds 0.5–0.6 lines long, obliquely ovate, or, where only one in a cell is developed, rostrate; hilum linear-oblong, short, in the former seeds perpendicular, in the latter transverse.

The specimens from Bolivia have larger, less glandulous, and paler flowers, $1\frac{1}{4}$–$1\frac{1}{2}$ lines long, "yellowish-white or rose-colored," but do not differ in any other respect.

35. C. UMBELLATA, HBK.! N. Gen. Sp. III. 121; DC. Prod. IX. 460. *C. parviflora*, Willd.! Hb. nro. 3163. — This species seems to have been unknown to all later botanists, with the exception of Torrey, who recognized Humboldt's plant in a specimen collected by Long's expedition to the Rocky Mountains. Lately it has turned up from many localities along the United States and Mexican boundary line, from northern Mexico, and from the Antilles. In Brazi a form has been collected which I cannot specifically distinguish from the Mexican plant. — The flowers of this species are arranged in loose compound fasciculate cymes, the ultimate divisions forming umbels of 3–5–7 flowers, supported by a single ovate-lanceolate bract; pedicels usually longer than the flower; flower, with the lobes of the corolla erect, $1\frac{1}{2}$–2 lines long; calyx broadly campanulate, thin and shining, at least when
dry; lobes triangular, acute, as long or longer than the shallow tube of the corolla; laciniæ narrowly [488 (38)]
lanceolate, elongate, acute, longer than the tube, spreading or reflexed; scales usually broadly oval, large,
longer than the tube, incurved; styles much longer than the globose-depressed ovary, rarely of same length; corolla enveloping the small, thin, depressed, almost 4-lobed capsule, which is commonly circumscissile, but in some instances rather irregularly bursting; seeds generally all four developed, 0.5–0.6 lines long, triangular, oblique, with a very short linear hilum.

It is always found in dry places on low herbs, especially *Portulaca*, also *Kallstræmia*, *Amarantus*, *Atriplex*, *Polygonum*, etc., and sometimes even on some prostrate *Euphorbiæ:* between Queretaro and Salamanca, Humboldt! Saltillo and Camargo, Gregg! Western Texas, New Mexico, and Arizona, Wright! 1627, 1636, 1639 (371, 510, 695), Bigelow! Schott! Santa Fé, Fendler! 659; foot of the Rocky Mountains, James! Jamaica, Broomfield! Purdie!

Dr. Hays found a specimen on the San Pedro River, Arizona, on *Suæda*, with much more dense inflorescence, greatly resembling a form of *C. Californica*, — which will be noticed below, — parasitic on the same saline plant, and mainly distinguished by the broadly campanulate, not turbinate, calyx, the circumscissile capsule, and the seeds.

Some specimens from New Mexico show a tendency to papillose pubescence; and one from Sonora, Coulter! 1010, on some *Euphorbia*, has the unusually small flowers (1 line ong) quite papillose-scabrous.

Var. β.? DESERTORUM. *C. desertorum*, Martius! in Hb.: pedicels long; flowers less crowded, smaller, 1 line long; lanceolate-linear laciniæ twice as long as tube; scales small, bifid or reduced to two lateral toothed lobes; styles shorter than the exsert capsule, which is circumscissile with a small opening; intrastylar aperture large; seeds only 0.4 line long. — On *Portulaca* and *Ehrenbergia*, in the province of Piauhy, Brazil, Martius! — Another similar form, but with longer tube and shorter laciniæ and rather larger scales, was collected by Gardner! 2425, in the province of Ceara, in the same neighborhood, also on *Portulaca*.

A specimen from the island of Antigua in Hb. Martius, Wullschlægel! 352, seems to belong here, though the (unripe) capsules do not open; flowers larger and more densely clustered than in the common form, calyx and capsule glandulous, intrastylar aperture large.

36. C. GRACILLIMA, n. sp.: caulibus tenuissime capillaceis demum deciduis; floribus in fasciculos decompositos demum dense glomeratos congestis; bracteis lineari-lanceolatis; pedunculis ramosissimis; pedicellis capil-
laceis flore gracili longioribus; calycis turbinati lobis lanceolatis sæpe apice recurvis tubum corollæ paulo [489 (39)]
superantibus; laciniis lanceolatis subulatis tubo multo longioribus erectis apice subrecurvis; staminibus
lacinias superantibus, filamentis e basi subulata capillaceis, antheris ovatis; squamis laceris fimbriatis incurvis tubum excedentibus; ovario parvo globoso, stylis capillaceis longissimis antheras fere attingentibus; capsula corollæ rudimento indusiata demum irregulariter transverse disrupta; seminibus lenticularibus læviusculis. — *C. fœtida*, Hook. & Arn.! Bot. Beechy, 304, non HBK. *C. subtilis*, Chaubard! in Hb.

Mexico, Mornay! in Hb. Delessert; Tepic, Beechy! in Hb. Hooker; Jürgensen! in Hb. Mus. Florent. — The only species known to me with stamens longer than the lobes of the corolla; distinguished also by the large and dense masses (in one specimen over 1 inch thick and 2–3 inches long) of flowers; pedicels branched but scarcely umbellate, mostly much longer than the flowers; flowers small and slender, $1\frac{1}{4}$–$1\frac{1}{2}$ lines long; capsule opening late and irregularly; intrastylar aperture quite small; seeds usually two, 0.5 line long, compressed, rounded, slightly oblique at base, with a very short transverse or oblique hilum. — Closely allied to *C. umbellata;* principally distinguished by the inflorescence, the turbinate calyx, the smoothish seed. Less important differences are the erect laciniæ and long filaments.

Var. *β.* SACCHARATA: bracteis pedicellis totoque flore papilloso-adspersis; laciniis staminibus stylisque brevioribus; seminibus minoribus. — *C. Sidarum*, Liebm.! in Hb.

On the coast of Oaxaca, parasitic on different species of *Sida*, Liebmann! in Hb. Hooker. — Inflorescence the same as in the species; flowers even smaller, $1\frac{1}{4}$ lines long; laciniæ shorter; stamens shorter; anthers orbicular; capsule readily circumscissile; seeds 0.4 line long.

37. C. LEPTANTHA, n. sp.: caulibus capillaceis; bracteis ovatis acuminatis; pedicellis filiformibus lævibus umbellato-fasciculatis; floribus 4-meris gracilibus; calycis granulato-hispidi lobis triangulatis acutis tubo corollæ cylindrico dimidio brevioribus; laciniis lanceolatis acutis erecto-patulis tubo multo brevioribus; filamentis filiformibus cum antheris ovatis brevioribus lacinias subæquantibus; squamis ovatis dentato-fimbriatis tubo multo brevioribus; ovario parvo globoso, stylis capillaribus longissimis demum exsertis; capsula corollæ basi hispidula indusiata calyptraque circumscissa; seminibus globoso-triangulatis verruculosis.

Western Texas, Chs. Wright! 1849, nro. 522; prairies of the Leona, in the same region, the same! 1852, nro. 1639 in part (mixed with *C. umbellata*), in both instances on *Euphorbia albo-marginata.* — This is the only *Cuscuta* seen by me with (thus far) constantly 4-parted flowers. Flowers 2–$2\frac{1}{4}$ lines long, pedicels sometimes twice as long; calyx campanulate-globose, short in proportion, about $\frac{3}{4}$ line long, as well as the [490 (40)] base of the tube in all the specimens seen, papillose or, in the dry plant, scabrous; tube of the corolla slender, much longer than calyx; corolla enveloping the small capsule and contracted above it, capsule readily opening at base with a wide aperture; seeds 2–4, almost globose, 0.4 line long, with a very short hilum.

38. C. HYALINA, Roth! Nov. Spec. p. 100, not Wight, nor Boissier. *C. Arabica*, Wight, Ic. t. 1371, not Fresenius. *C. oxypetala*, Boissier! Diag. Or. II. 3, 130. *C. acutissima*, Buchinger! mss. in Pl. Schimper. — This well-marked species of the tropical parts of the East Indies (Heyne! Stocks! 478; Hooker & Thomson! and others), extending into Abyssinia (Schimper! 1522), is certainly the plant Roth had in view, as the specimens with Heyne's and with Roth's own labels in the Hb. of the Botanical Garden of St. Petersburg prove. Roth's description, however, cannot but have misled all future authors, as he speaks of scales, no trace of which is present in the different specimens I had occasion to examine, not even in Roth's own, nor are the flowers usually 4-parted, but almost always 5-parted.

Boissier, l. c., already mentions that the capsule bursts irregularly. Whether it more readily opens when fully ripe is unknown, but in all the specimens examined it rather adheres to the base in the calyx, and bursts only when some force is used, the deeply bilobed lower part of the dissepiment remaining with the base. It therefore very properly comes in at the end of this section, uniting it with the next.

With *C. Californica* this species is closely connected, and, indeed, is sometimes difficult to distinguish from it; but the texture of all the parts is thinner, semi-transparent, and shining, at least when dry; hence Roth's name is quite appropriate. The adnate parts of the filaments are distinct, but no trace of scales is visible; the ovary is conic; the styles are still more hair-like and on the capsule divaricate; the seeds usually ripen all four, — they are triangular, flattened, with the short, almost oblong hilum perpendicular or transverse, both forms being found in seeds from the same capsule.

SECT. 6. CLISTOGRAMMICA.

Styles of unequal length, cylindric, rarely almost absent; stigmata capitate. Capsule never opening at base, baccate, persistent with the calyx, or separating from it entire; intrastylar aperture often large, but generally not penetrating into the capsule. Seeds four in each capsule, or fewer, sometimes only one; rounded or usually triangular-flattened, often rostrate; hilum linear, short or longer, transverse or oblique or perpendicular.

Inflorescence variable; either an umbelliform or somewhat globose cluster with pedicelled flowers; [491 (41)] or a loose racemiform or paniculate cyme, finally more or less crowded; or (in the four last species) compact and often continuous clusters of closely sessile flowers with many sterile bracts. The corolla remains either at base or around the capsule or covers its top.

This section is the richest in species, and the most common in North and South America and on the Islands of the Pacific. One species (*C. obtusiflora*) is a cosmopolite, being found in North and South America, Oceanica, Asia, and Europe; and one (*C. appendiculata*) is peculiar to South Africa.

§ 1. Platycarpeæ.

Flowers pedicelled; sepals united; ovary and capsule globose-depressed, with walls of uniform thickness (in some forms of the last species conic).

* Flowers arranged in single or compound subglobose cymes; styles usually short and thick; withered corolla remaining at base of capsule.

39. C. OBTUSIFLORA, HBK. — Humboldt's plant is the type of a series of forms spread over a great part of the globe. The inconspicuous little species of the Peruvian Andes was not recognized nor sought for in the specimens found in widely distant parts of the globe; these, therefore, received distinct specific appellations, and different ones in different countries. They all are characterized by the bright orange-colored stems (which has suggested several specific names); the loosely globose inflorescence; the obtuse or rounded lobes of the calyx and the corolla, the laciniæ usually equal in length to the tube, and soon reflexed; the thick and at last subulate styles on the large and depressed ovary, which soon after flowering swells considerably, and, leaving the corolla at base, grows into a large, depressed, almost naked 4-seeded capsule, with a large intrastylar aperture of rhombic shape. Seeds 0.6 or 0.7 or even 0.8 line long, oval, oblique, with a long and narrowly linear perpendicular or transverse hilum running almost across the whole umbilicus. All parts of the flower are often, and the capsule commonly, glandulous-dotted. The principal, if not the only, difference I can discover between the different forms here united lies in the shape and size of the scales.

Synopsis of the forms of C. obtusiflora.

a. Scales ovate or spatulate.
- * Scales small, shorter than the tube of the corolla: Var. *vera*, from South America.
- ** Scales large, equalling or exceeding the tube of the corolla; all parts of the flower dotted with glands: Var. *glandulosa*, from the West Indies and the southern parts of the United States.
- *** Lobes of calyx and corolla broadly oval, or almost orbicular; scales large: Var. *latiloba*, from India. [492 (42)]

b. Scales bifid and often very small.
- * Flowers 5-parted, usually glandulous; scales very small, sometimes almost obliterated: Var. *australis*, from New Holland and China.
- ** Flowers often 4-parted, scarcely glandulous; scales as in the last: Var. *breviflora*, from southern Europe.
- *** Flowers and scales larger; lobes of calyx and corolla narrower: Var. *Cesatiana*, from Italy and Central Asia.
- **** Calyx large, cupulate, lobes somewhat carinate: Var. *Cordofana*, from Africa.

Var. *a.* VERA. *C. obtusiflora*, HBK.! N. Gen. Sp. III. 122. *C. inodora*, Willd.! Hb. nro. 3164. — Flowers scarcely more than 1 line long; lobes of calyx very unequal, as in many other forms of the species; scales spatulate, very small and thin, but slightly fimbriate or crenate; capsule 1¼–1½ lines in diameter, dotted with, in the dry state, dark red glands. — Andes of Peru, Humboldt! Guayaquil, Jameson! 542; New Grenada, Holton! 544, a specimen with more slender styles; Triana, Linden! 168; Antioquia on the Magdalena River, Jarvis! 1500. This last specimen, with a glandulous corolla and rather larger, more deeply fimbriate scales, forms a transition to the next.

Var. *β.* GLANDULOSA: calyx, corolla, and capsule dotted with red and shining glands; calyx shorter than tube in some and quite as large as that in other specimens; scales large, often exceeding the tube, deeply fringed, incurved; flower 1–1¼ lines long; capsule 1½–1¾ lines in diameter. — Parasitic on *Polygonum* in most of the specimens examined; Georgia, Boykin! Florida, Rugel! 400; Louisiana, Tainturier! Western Texas, Wright! Bigelow! Schott! Bahama Islands, in Hb. Hooker! Cuba, Pœppig! under the name of *C. Americana*.

Var. *γ.* ?. LATILOBA: flowers larger, 1½ lines long, of a more fleshy or, when dry, coriaceous substance; calyx and capsule glandulous; lobes of calyx very unequal; these, the lobes of the corolla, and the large, deeply fringed scales broadly oval, almost orbicular; styles short, thick. — Martaban, Wallich! Cat. 1320[3] under the name of *C. sulcata*. — It seems to differ from *C. obtusiflora* by the more fleshy erect lobes of the corolla, and especially by the more paniculate than globose inflorescence, but it certainly cannot be united with *C. sulcata* (*Chinensis*), where Wallich and Choisy place it. The specimens are without fruit.

Var. *δ.* AUSTRALIS. *C. australis*, R. Brown! Prod. I. 491. — Flowers in this, as in all the forms enumerated above, 5-parted, scarcely more than 1 line long, dotted with glands all over; scales bifid or often reduced to one or a few lateral teeth; styles short, usually more slender than in the American forms. — *C. Millettii*, Hook. & Arn.! Bot. Beechy, 201, is the same plant, flowers rather less glandulous, styles stouter. — [493 (43)]
New Holland: Port Jackson, R. Brown! F. Bauer! Caley! Golbourn River, F. Mueller! Canton, China, Millett! — Mr. Mueller's specimen is almost destitute of glands and also of scales. Only here and there single or bifid teeth are noticed at the base of the filaments. I can distinguish it from the following form only by its 5-parted flowers.

Var. *ε.* BREVIFLORA. *C. breviflora*, Visiani! Fl. Dalm. II. 231. *C. Tinei*, Insenga! in Tin. Pl. Rar. Sic. p. 14. *C. aurantiaca*, Requien! in sched.; Bertol. Fl. It. VII. 623. *C. chrysocoma*, Welw.! in sched.; DesM. Et. 71.

C. Rogovitschiana, Traut. Mel. Biol. II. $\frac{1}{2}\frac{6}{8}$ Mart. 1855, ex descr. — Flowers 1–1½ lines long, usually 4-parted or 4- and 5-parted in the same specimen, only partially glandulous, or entirely destitute of glands; scales very small, bifid, or commonly consisting of small lateral teeth, or sometimes almost abortive. On the lower Wolga, Liemaschko! 227; Becker! Kiew, Trautvetter; Constantinople, Boissier! Greece, Zuccarini! Berger! Dalmatia, Stalio! Alexander! Naples, Gussone! Capua, abundant in fields of hemp, Bruni! Syracuse, Insenga! Corsica, Requien! Toulon, Quillon! Montferrand, Ramond! Portugal, Welwitsch! — It is often found in gardens on Basilicum, and is probably often propagated and transported with the seeds of that plant. The Basilicum with the parasite is called in the gardens about Naples "basilico con perrucche;" just as the old botanists used to call the grapes, to which *C. Epithymum* sometimes attaches itself, "uva barbata." — In France this form has often been named *C. Europæa;* and DesMoulins, Et. p. 67, etc., confounds it with *C. suaveolens.*

Var. ζ. CESATIANA. *C. Polygonorum*, Cesati! in Cat. Sem. Gen. 1849, p. 22, and Linnæa XXIV. 199, not Engelm. *C. Cesatiana*, Bert.! Fl. It. VII. 623. — Flowers 1½ lines long, 5-parted, without glands; lobes of corolla narrow, longer than the tube; scales usually exceeding the tube, deeply laciniate and more or less bifid. — Piedmont, on *Polygonum*, Cesati! Cashmere, Jacquemont! 876. — The strange fact, that exactly the same form should be found a native of so widely distant localities, furnishes but another instance of the cosmopolitan habits of this species. — Professor Cesati, l. c., gives the first correct account of the *apparent* intrastylar dehiscence of the capsule in the following words: "Capsula . . . ob dissepimenti exsiccationem . . . hians, . . . hinc capsulam apice dehiscentem *mentiens.*"

Var. η. CORDOFANA: calyx large, cupulate, longer than the tube of the corolla; its lobes united above the middle, somewhat carinate; scales as in var. *australis;* stamens and style shorter than in any [494 (44)] other form of the species. — Fezogl, Cordofan, Figari! in Hb. Mus. Florent.

40. C. CHLOROCARPA, Engelm.! in Gray Man. ed. 1, p. 350*; ed. 2, p. 337. *C. Polygonorum*, Engelm.! in Sill. Journ. XLIII. p. 342, t. 6, f. 26–29; DC. Prod. IX. 461, not Cesati. — Along ponds and wet places, mostly on different species of *Polygonum*, and also on other plants of these localities; St. Louis, Missouri, Drummond! Lindheimer! Engelmann! Illinois, Engelmann! Wisconsin, Lapham! Indian country west of Arkansas, Bigelow! eastward thus far only in Delaware, Tatnall! — Closely allied to the last species, especially to var. *breviflora;* the principal difference lies in the triangular, acute lobes of calyx and corolla. Flowers usually 4-parted, about 1 line long; scales small, bilobed, or oftener consisting of small lateral teeth, — in a specimen from Delaware they are very incomplete, or sometimes almost wanting; large ovary filling the shallow tube of the corolla; capsule comparatively large, thin, membranaceous, of a greenish yellow color, — whence the name, which I substituted for my former one, referring to the plants on which it is often found; this color of the capsule distinguishes it already at a distance from other species growing in the same region. Seeds 0.8 line long, oval, compressed, scarcely angled; transverse hilum rather shorter than in the last species.

41. C. ARVENSIS, Beyrich! in sched.; Engelm.! in Gray Man. ed. 2, p. 336. — The different varieties of this species are characterized by smaller flowers (often less than 1 line long) in more compound clusters, which approach in their form to those of the next species; lobes of calyx very obtuse; lobes of corolla almost always longer than the tube, acute or usually acuminate, reflexed and with the point inflexed; anthers broadly oval or rounded; scales large, deeply laciniate-fimbriate, often exceeding the tube; styles rather slender, as long as ovary or longer; seeds 0.5–0.7 line long, oval or rounded, compressed, with a rather short, linear, often oblique hilum. The differences in the shape, size, and texture of the calyx constitute the following varieties.

Var. α. PENTAGONA. *C. pentagona*, Engelm.! in Sill. Journ. XLIII. p. 340, t. 6, f. 22–24; DC. Prod. IX. 461. *C. arvensis*, Beyrich! in Hb. *C. globularis*, Nutt.! in Hb. — Calyx thin and shining; lobes orbicular, as long or longer than the shallow tube of the corolla, forming where they join five projecting angles. — Dry barren soil or old fields on different *Compositæ* or other plants, sometimes also on shrubs; from Virginia, Rugel! Sullivant and Gray! to the Carolinas, Schweinitz! Bosc! Beyrich! Curtis! Ravenel! and to Florida, Rugel! nro. 400, a. and b. [495 (45)]

The western form, with shorter lobes of the less distinctly angled calyx, was formerly distinguished by me as var. *microcalyx.* — In open woods, on dry soil, on *Solidago*, *Aster*, *Ceanothus*, etc., Illinois, Geyer! Missouri, Trécul! Riehl! Nebraska, Hayden! Indian country west of Arkansas, Bigelow! The latter has often as large a calyx as the eastern form.

Var. β. VERRUCOSA. *C. verrucosa*, Engelm.! l. c. p. 341, t. 6, f. 25; DC. Prod. IX. 461. — Calyx shorter than the campanulate tube, fleshy and glandular-verrucose. — On dry prairies, often on *Petalostemon*, but also on other prairie plants: Texas, Drummond! III. 247; Lindheimer! 127; Northern Mexico, Berlandier! 2457, to San Luis

* The original descriptions of species characterized by Dr. Engelmann in the Manual, etc., will be found in the collected descriptions at end of *Cuscuta* matter. — EDS.

Potosi, the same! and Parras, Gregg! — Lindheimer's nro. 473 is an intermediate form between this and var. *pentagona*, mixed with a few specimens of the following.

Var. γ. PUBESCENS: pedicels and all parts of the flower or only the ovary and the capsule papillose-pubescent. — Western Texas, Lindheimer! Wright! 1635 (574). — Wright's 519 and 523 (coll. 1849) are a transition form between this and the last variety, having the calyx of *verrucosa* and the ovary and capsule of *pubescens*.

Var. δ. CALYCINA: inflorescence often more compact; flowers rather larger; hemispherical calyx not angled, lobes rounded or oval, usually longer than the tube; lobes of corolla broader and shorter than in the other forms, and often not longer than the tube. — Texas, Lindheimer! 126 (a form from wet prairies, with smaller flowers); the same! 664; Wright! both on *Dianthera*, in or along water-courses; Martinique, Mad. Richard! 114 in Herb. Mus. Flor.; Herb. Fauché! (now in Hb. Boissier); Saskatchawan, Drummond! *C. Americana?* Hook. Fl. N. A.; Oregon, Geyer! 674.

Specimens from Brazil Eschscholtz! in Hb. Ledebour; Gardner! 6068 in part (*C. decora* has also been distributed under this number) differ somewhat from this variety by stouter and, in fruit, subulate styles; Gardner's specimens have also a smaller calyx.

* * Flowers arranged in loose compound cymes; styles usually slender, as long or longer than ovary; withered corolla remaining at base of capsule or enveloping it.

42. C. TRICHOSTYLA, n. sp.: caule filiformi; bracteis ovatis obtusis; floribus breviter pedicellatis in cymulas ramosas subglobosas congestis; calycis cupulati fere ad basin divisi lobis ovatis orbiculatisve [496 (46)] obtusis basi imbricatis tubum corollæ campanulatum æquantibus seu superantibus; laciniis ovatis obtusis tubo æquilongis demum patulis reflexisve; antheris ovatis filamenta subulata brevia æquantibus; squamis late ovatis fimbriatis incurvis; stylis capillaribus ovario depresso multo longioribus e tubo vix exsertis.

Parana, Tweedie! Santarem, Brazil, on *Hyptis*, Spruce! 854, both in Hb. Hooker. — None of the specimens examined being in fruit, the true position of this species must remain doubtful. The large imbricate calyx, the slender styles, and especially the branching inflorescence, distinguish it from *C. obtusiflora;* the inflorescence, the shape of the ovary and of the styles, from *C. Gronovii* and *C. racemosa.* — Flowers 1¾–2 lines long, "white, with a strong odor of hawthorn," Spruce; exterior lobes of the calyx in the Panama specimen towards the tip verrucose-cristate; in the other smooth, thin, and shining; scales in the former longer than the tube, in the other broader and shorter.

43. C. GYMNOCARPA, n. sp.: caule filiformi; floribus breviter pedicellatis umbellato-glomeratis; calycis lobis ovatis seu orbiculatis obtusissimis nitidis tubum corollæ æquantibus; laciniis triangulatis acutis erectis seu demum patentibus tubo æquilongis; antheris ovato-orbiculatis filamentum breve subulatum æquantibus; squamis tenuissimis late ovatis fimbriatis faucem attingentibus; stylis capillaribus ovarium depressum æquantibus supra capsulam globoso-depressam e corolla ad basin marcescente longe exsertam divaricatis patentibus recurvisve; seminibus oblique ovatis tumidis tenuissime sub lente reticulatis. — *C. Sandwicensis*, var. *Mimosæ*, Hook. fil. in Linn. Trans. XX. 205.

James Island, of the Galapagos group, in immense abundance on *Mimosa* bushes, Chs. Darwin! in Hb. Hooker. — Flowers about 1 line long, of a very thin texture; capsule 1¼–1½ lines in diameter, with a very small intrastylar aperture; seeds, in the only specimen extant, light yellowish brown, 0.6 line long, plump, nearly smooth, with a short, oblong-linear, usually perpendicular, hilum. — Much closer to *C. arvensis* than to *C. Sandwichiana;* distinguished from both by the short, broad, and very acute lobes of the corolla, and by the very slender, at last nearly horizontal, styles; from the latter also by the presence of scales and by the naked capsule.

44. C. SANDWICHIANA, Choisy! Cusc. 184, t. 5, f. 4; DC. Prod. IX. 458. — Sandwich Islands; apparently the only species growing there; mostly on shrubs; Menzies! Eschscholtz! Gaudichaud! Matthews! Stewart! Maximowitsch! 57; Remy! 424. — Inflorescence a compound loosely-flowered cyme; flowers pedicelled, 1–1½ lines long, "pallide ochracei" Maxim., of thin, membranaceous texture; only in Menzies' specimen in Hb. [497 (47)] Banks I find all the parts of the flower dotted with glands; lobes of calyx ovate, acutish; lobes of corolla acute and inflexed at tip or sometimes obtusish, often reflexed, but at last commonly adpressed to the top of the capsule, which for its greater part is enveloped by the tube; anthers oval; no trace of scales; capsule 1¾–2 lines in diameter, with a small, almost circular, intrastylar aperture; styles stouter than in the last species, somewhat divaricate on capsule; seeds unusually large, 0.8–1.0 line long, verrucose-reticulate, triangular-ovate, somewhat oblique but not rostrate, with a short linear-oblong perpendicular hilum on the comparatively small regularly circular umbilicus.

45. C. ACUTA, n. sp.: caulibus subcapillaceis; cymis compositis laxifloris umbellulas mentientibus; pedicellis flore brevioribus bracteis ovatis acutis suffultis; calycis late campanulati membranacei lobis triangulatis acutis seu cuspidatis tubum corollæ campanulatum superantibus; laciniis lanceolatis acutatis tubo longioribus erectis seu subpatentibus; antheris oblongo-linearibus filamento subulato fere brevioribus; squamis ovato-spatulatis longe adnatis

faucem attingentibus versus apicem crispato-fimbriatis; stylis capillaceis ovarium obovatum seu globosum æquantibus; capsula tenuissima corollæ rudimentis ad basin persistentibus indusiata apice libera stylis e basi lata subulatis paulo divergentibus coronata; seminibus 2–4 lenticularibus rugoso-reticulatis.

Chatham Island, of the Galapagos group; mostly on *Leguminosæ*, common on a low annual *Crotalaria*, but also on trees, such as *Parkinsonia* and *Mimosæ*, hanging down in massy festoons, Andersson! — Closely allied with both other Pacific species just described, distinguished from them by the very acute lobes of calyx and corolla and by the subulate styles; moreover from *C. Sandwichiana* by the presence of scales, and from *C. gymnocarpa* by the covered capsule and the direction of the styles; from *C. acutiloba* of the mountains of the neighboring coast and from *C. umbellata* it differs by the inflorescence, by the baccate capsule, etc. — Flowers 1–1¼ lines long; scales adnate nearly to the apex, crenulate on the sides, fringed only at tip; capsule about 1 line in diameter; intrastylar aperture large, forming a transverse slit; seeds only 0.5 line long, dark brown in the specimen before me (perhaps not perfectly ripe); and strongly reticulate; hilum short, oblong-linear, perpendicular or oblique. — The specimens examined by me were all on a low Crotalaria.

*** Flowers arranged in branching paniculate cymes; styles slender, as long or longer than ovary; withered corolla surrounding the capsule or covering its top.

46. C. TENUIFLORA, Engelm.! in Gray, Man. ed. 1, p. 350; ed. 2, p. 336. *C. Cephalanthi*, Engelm.! [498 (48)] in Sill. Journ. XLIII. 336, t. 6, f. 1–6. — Wet places, often on *Cephalanthus*, *Salix*, *Cornus*, and other shrubs, but also on *Vernonia*, *Aster*, and other herbaceous plants; Missouri and Illinois, Engelmann! Geyer! Upper Missouri country, Hayden! New Mexico, Wright! 1629 (124); Arizona, the same! 1626 (578). — In young plants just beginning to flower the cymose-paniculate inflorescence is very distinct, — the terminal flowers of the main branches of the inflorescence opening first, and lateral clusters of smaller and ever smaller buds appearing lower down on the peduncles; a little later the fruits occupy the ends of the branches, while more and more flowers and buds are developed on lateral peduncles and pedicels, till at length the whole becomes one large and intricate, and often quite compact, cluster. Short pedicels, gradually swelling into the base of the turbinate calyx; flowers ordinarily 1 line or less in length, mostly 4-parted, later flowers often only 3-parted; tube of the corolla slender, much longer than the calyx, and larger than the short ovate obtuse laciniæ; scales ovate or spatulate, shorter than the tube; capillary styles as long as the depressed ovary; capsule globose, 1–1¼ lines in diameter, bearing the withered corolla on top, often with only one or two seeds; seeds 0.6–0.7 line long, oval, oblique, carinate on the inside, with a short linear-oblong usually perpendicular hilum. — The western forms collected by Mr. Wright differ from those of the Missouri and Mississippi valleys only by having larger flowers (1.2–1.4 lines long), larger, more depressed, mostly 4-seeded capsules (1½–2 lines in diameter) and larger (0.8 line long) flatter seeds.

Choisy, in DC. Prod. IX. 458, wrongly gives this very distinct species as a synonym of *C. compacta*, with which it has scarcely anything in common but the hooded capsule; from small flowered forms of *C. Gronovii* it differs by the position of the dead corolla and by the structure of the ovary and capsule.

47. C. CALIFORNICA, Choisy! Cusc. 183; DC. Prod. IX. 457; Hook. & Arn.! Bot. Beechy, 364. — Both authors described this plant from Douglas's specimens under the same name and in the same year (1841); Nuttall, in the Hb. Acad. Philad., had named it *C. acuminata*. — Flowers on slender pedicels, loosely paniculate; calyx small, turbinate with acute triangular, lanceolate or acuminate and sometimes recurved lobes; laciniæ very slender, lanceolate-linear, acute or acuminate, erect or spreading, in fruit mostly erect or connivent; scales wanting, or indicated by a membranaceous inverted arch, with a smooth or crenulate margin connecting the adnate parts of the filaments near the base of the corolla, — in a doubtful variety the scales are fully developed; styles capillary; [499 (49)] ovary small, usually globose; capsule enveloped by the corolla; seeds often solitary, subglobose, slightly compressed, strongly hooked, 0.5–0.6 line long.

The different specimens examined vary considerably in the shape and length of the calyx, the proportion of the laciniæ to the tube, the length of the filaments, the indication of scales, the length of the styles, and even the shape of the ovary.

Var. *α*. BREVIFLORA: flowers scarcely more than 1 line long, on short pedicels; laciniæ rather longer than tube; anthers, filaments, and styles short; seeds several. — Monterey in fields, Hartweg! 1863.

Var. *β*. GRACILIFLORA: flowers slender, 1½–2½ lines long; calyx often shorter than tube of corolla; laciniæ as long as the tube, very narrow; filaments often short, or as long or longer than the linear-oblong anthers, styles as long or much longer than ovary. — California, Douglas! Fremont! 506; Bigelow!

Var. *γ*. LONGILOBA: flowers 2–2½ lines long; calyx usually equal to the tube, rarely shorter, sometimes longer; laciniæ slender, sometimes twice the length of the tube; subulate filaments as long or longer than the oblong-linear anthers; styles very long and slender. — California, principally, as it appears, on the coast of the southern parts of the State, and commonly on some species of *Eriogonum*: Sta. Barbara, Nuttall! San Diego, Thurber! 570 & 633; Newberry!

Var. δ. APICULATA : corolla somewhat granulate, ovary and 1-seeded capsule conic, apiculate ; otherwise very similar to the last. — On the Colorado, Bigelow ! in February.

Var. ε. ? SQUAMIGERA : flowers 2–2½ lines long, on pedicels shorter than the flower, or even the calyx, in rather crowded subglobose clusters ; lobes of calyx lanceolate, acuminate, as long as the open, funnel-shaped tube of the corolla ; laciniæ lanceolate, as long as the tube, at last spreading ; anthers oblong-linear, cordate at base, on very short filaments ; scales spatulate, fringed, shorter than the tube, incurved ; styles as long as the very acute ovarium ; capsule apiculate, 1-seeded, lower half enveloped by the tube of the corolla. — The more densely clustered flowers, the presence of scales and the acute ovarium would seem to specifically distinguish this form, but the last mentioned variety appears to unite it with the common form ; perhaps it ought to be classed with the next species. — Saline soil on the Rio Virgen, Utah, on *Suæda*, J. Remy ! in Hb. Mus. Paris.

§ 2. Oxycarpeæ.

Flowers subsessile, or pedicelled ; sepals united ; ovary and capsule thickened towards the apex, usually more or less conic.

* Flowers subsessile, crowded in rather dense, small or large and compound glomerules ; withered [500 (50)] corolla enveloping or covering the 1–2-seeded capsule.

48. C. SUBINCLUSA, Durand & Hilgard ! in Journ. Ac. Phil. III. p. 42, and in Pacif. R. R. Rep. V. 3, p. 11. — This fine and large-flowered species resembles different forms of *C. corymbosa* and *C. odontolepis* so much, that I felt considerably inclined to unite all of them as varieties of one and the same species ; but then the dehiscence or non-dehiscence of the capsule would have to be considered as a character of not even specific importance ; there are, however, also other differences, so that these species must be viewed as representing different types under a similar external form. — Flowers 2–3 lines long, on very short pedicels or almost sessile, paniculate-glomerate, at last forming large and rather dense clusters ; cylindrical tube of corolla longer than the deeply divided calyx ; lobes fleshy, ovate-lanceolate, acutish, imbricate ; laciniæ ovate, acute, more or less crenulate, shorter than the tube, erect or patulous ; anthers oblong or ovate, cordate, usually longer than the filaments, or even subsessile ; scales scarcely reaching above the middle of the tube, spatulate-oblong, deeply fringed ; styles slender, much longer than the 2-pointed ovary, at first scarcely exsert ; capsule oval, 1–2-seeded, its upper part capped by the withered corolla ; seeds 0.7–0.9 line in diameter, rough, oval or subglobose, oblique or almost hooked, with a very small oblong hilum.

On the Tejon Pass in the southern part of California, on *Salix* and *Artemisia*, Heermann ! in the same region on *Cratægus*, Le Conte ! Sierra Nevada, above Placerville, Remy ! Saline marshes on Mare Island, Bay of San Francisco, on *Grindelia*, Wright ! — It is remarkable, but in this genus not unusual, that specimens from the high mountains are absolutely identical with those from the salt marshes of the coast ; the only difference I can discover consists in the flower being a little larger, the filaments longer and the anthers shorter.

Var. β. ABBREVIATA : lobes of calyx more membranaceous, less deeply divided, scarcely imbricate, rather longer than the short funnel-shaped tube of the corolla ; laciniæ as long as tube ; styles as long as the conic ovary, shorter than the oval capsule which is entirely enveloped by the corolla. — Mare Island in San Francisco Bay, on *Arthrocnemon*, Wright !

49. C. MICRANTHA, Choisy ! Cusc. 175, t. 1, f. 3 ; DC. Prod. IX. 453 ; Gay ! Fl. Chil. IV. 446. — A small-flowered and low species, perhaps the lowest one in South America, peculiar to Chili : Coquimbo, on the shore of the Ocean, always on *Frankenia*, Cl. Gay ! 538 ; Concon, on *Plantago*, *Trifolium*, etc., Pœppig ! 89 under the name of *C. Popayanensis ;* St. Jago, Dr. Philippi ! Besser ! — Flowers about one line long on short pedicels [501 (51)] or almost sessile, in small compact clusters ; lobes of calyx and corolla broadly triangular, acute, the latter often somewhat crenulate ; scales usually small, ovate or spatulate, attached to the middle of the tube and scarcely reaching to the throat ; styles capillary, usually much shorter than the conic ovary ; stigmas rather small but very distinctly capitate, so that it is difficult to understand how Choisy could place this species among those with filiform stigmas ; even his own figure, though not quite correct, does not bear him out. — Capsule oval, 1-seeded, enveloped in the corolla, with top naked ; seed 0.6 line long, compressed obovate, rostrate, rough, with a very small hilum reduced to almost a point. This is Choisy's original plant, from Coquimbo ; all the other specimens cited above belong to

Var. β. LATIFLORA : flowers rather larger, 1¼–1½ lines long, petals spreading, scales often larger, styles longer ; fruit not seen. Some of Pœppig's plants approach the original specimens by their small flowers and crenulate laciniæ.

* * Flowers pedicelled, disposed in rather loose paniculate cymes, which often at last become crowded ; withered corolla usually enveloping the capsule or covering its top, in the three last species investing only its base.

† Lobes of corolla acute or rarely obtuse, inflexed or corniculate at the apex.

50. C. DECORA, Choisy, under the name of *indecora*. Choisy saw only a very poor blackened specimen, such as Berlandier was in the habit of making, of the small-flowered variety ; but it so happens that this is one of the prettiest species,

so much so, that Scheele has named it *pulcherrima;* I therefore feel justified in the liberty I take with Choisy's name in lopping off its negative *in.* — This is a wide-spread and quite variable species, extending from the United States to Brazil, always readily recognized by the structure of the fleshy white flowers, which consist of large convex cells, which make the surface appear rough and the margin crenulate; these cells are on the surface sometimes elongated into oval or cylindric papillæ; inflorescence loosely paniculate or in some forms at last more compact; lobes of calyx ovate or lanceolate, acute, of different lengths; laciniæ ovate-lanceolate, inflexed at the acute point, erect or spreading, not recurved; scales large, broadly oval; styles usually stout and very unequal, about as long as the conic ovary; capsule enveloped by the corolla; seeds usually several, 0.6–0.9 line long, obliquely ovate, rostrate, rough, with a very short, oblong, transverse hilum. The following varieties may be distinguished: —

Var. *α.* INDECORA. *C. indecora*, Choisy! Cusc. 182, t. 3, f. 3; DC. Prod. IX. 457. *C. neuropetala*, *β.* [502 (52)] *minor*, Engelm.! in Boston Journ. N. Hist. V. 223: flowers 1–1¼ lines long, on long pedicels, loosely panicled, with very short calyx. — On the Rio Grande, Berlandier! 865 & 2285; Texas, Lindheimer! 123, (in some of the distributed collections the numbers 123 and 124, both forms of this species, are transposed). — A papillose-hispid form of this variety is *C. verrucosa, α. hispidula* Engelm.! Sill. Journ. XLIII. p. 341. *C. hispidula*, Engelm.! ib. 45, p. 75; DC. Prod. IX. 461; Texas, Berlandier! 956 & 2386; Drummond! 248; Lindheimer! 474; Wright! Some of these specimens by their larger flowers approach the next form.

Var. *β.* PULCHERRIMA. *C. neuropetala*, Engelm.! l. c. 45, p. 75; DC. Prod. IX. 461. *C. pulcherrima*, Scheele! in Linnæa, 21, p. 750: smooth or rarely slightly papillose; inflorescence loose or sometimes more compact; flowers variable in size, 1¼–1¾ lines long, usually broadly campanulate; calyx as long or longer than tube; styles usually as long as ovary, rarely much longer; anthers and stigmas yellow or often purple. A form with very large and broad flowers is *C. neuropetala, γ. littoralis*, Engelm. Boston Journ. l. c. — On wet and dry prairies, from the sea-coast to the mountains, on different shrubs, also on herbaceous *Compositæ*, *Leguminosæ*, etc.: south-western Illinois, Engelmann! Indian country west of Arkansas, Fremont! 2d Exp. 485; Bigelow! Texas, Lindheimer! 124 (a very large-flowered form) 474, 475; and westward, Wright! coll. 1849, nros. 520, 521, 524, 525; coll. 1851–'52, nros. 1630, 1633, 1634, 1637, 1638; Sonora, Wright! 1622; Northern Mexico, Gregg! 78 and 888; Florida, Chapman! St. Marks, Rugel! 1000 & 1001; Cuba, Hb. Vind.! Jamaica, McFaddin! Bancroft! a small-flowered, short-styled form; Cumming! 95; Alexander! Brazil, Salzmann! in Hb. Buchinger; Gardner! 5036, a form with very long styles, and 6068 in part (*C. arvensis* var. has been distributed under the same number).

Var. *γ.* SUBNUDA: lower half of capsule enveloped by the tough remains of the corolla, upper part naked; short styles divaricate. — "Common on the overflowed islands of the Parana," Brazil, Tweedie! in Hb. Hooker.

Var. *δ.* INTEGRIUSCULA: calyx shorter than the deeply campanulate tube of the corolla; laciniæ erect; scales triangular, acutish, thin, almost entire; styles capillary, shorter than ovary. — Mendoza, on *Ephedra*, Gillies!

51. C. INFLEXA. *C. Coryli*, Engelm.! in Sill. Journ. XLIII. p. 337. *C. umbrosa*, Beyrich! in Hb. reg. Berol. in part, not Hooker; Engelm.! in Gray, Man. ed. 1, 351; ed. 2, 336. *C. parviflora*, Nutt.! in Hb. *C. congesta*, Beyr.! in Hb. *C. compacta*, var. *crenulata*, Choisy in DC. Prod. IX. 459. — In open woods or dry prairies, [503 (53)] usually on shrubs, *Corylus*, *Ceanothus*, *Symphoricarpus*, *Rhus*, *Salix* and even on *Carya*, but also on *Helianthus*, *Solidago* and other Compositæ, etc. Virginia, Beyrich! Gray & Sullivant! Georgia, Beyrich! Illinois and Missouri, Engelmann! Riehl! Kansas, Fendler! 658; region west of Arkansas, Bigelow! on the Upper Missouri and Yellowstone Rivers, Hayden! — Flowers 1 line long, of similar structure to the last; distinguished by the deeper subcylindric, mostly 4-parted corolla, which at last covers only the top of the capsule, the erect, inflexed laciniæ and the minute scales, reduced to lateral teeth; styles of different lengths, divaricate on capsule; seeds ovate, oblique, thick, 0.6–0.7 line long, with a small, oblong, oblique or transverse hilum.

52. C. APPENDICULATA, n. sp.: caulibus capillaceis; cymis fasciculato-paniculatis laxifloris; calycis brevissimi basi glanduloso-appendiculati lobis ovatis acutis tubum profunde campanulatum vel subcylindricum dimidium vix æquantibus; laciniis ovato-lanceolatis demum reflexis apice acuto incurvis tubo æquilongis; antheris ovato-orbiculatis cordatis filamento longioribus; squamis obovatis crispato-fimbriatis faucem æquantibus incurvis; stylis tenuibus ovario acuto subæqualibus; capsula globosa apiculata sub-1-sperma exserta supra medium nuda, foramine intrastylari magno; seminibus ovato-subglobosis obliquis.

Cape of Good Hope, on *Erica* and other shrubs: Zwellendam, "on dry hills throughout the whole district," Kraus! nro. 1816, under the name of *C. Africana;* Teufelsberg, in Hb. Fischer! now Hb. H. B. Petropol. — The only South African species belonging to this section; distinguished by the very small (scarcely ¼ line long) appendiculate calyx, etc.; flowers 1–1¼ lines long; seeds 0.6 line long.

53. C. STENOLEPIS, n. sp.: caulibus capillaceis; cymis paniculatis laxis paucifloris; pedicellis elongatis bractea ovata suffultis; calycis turbinati glandulosi lobis ovatis obtusis tubo corollæ subcylindrico brevioribus; laciniis tubo brevioribus lanceolatis reflexis apice acutiusculo incurvis; staminibus brevissimis, anthera ovata filamento subulato æquilonga; squamis angustissimis parce fimbriatis faucem vix attingentibus incurvis; stylis ovarium conicum bicuspe

subæquantibus demum exsertis ; capsula globosa apiculata sub-1-sperma apice corolla calyptræformi tecta ; seminibus subglobosis asperatis.

Andes of Quito, Fr. Hall! in Hb. reg. Berol. ; J. P. Couthouy ! on a *Dalea* "on the banks of the Machange, 9,500 feet high." — A very distinct species covering low shrubs with intricate masses of their hair-like stems, with scattered loosely flowered panicles ; whole plant filled with a reddish-yellow juice ; flowers [504 (54)] scarcely more than 1 line long ; scales very narrow, linear, irregularly and sparsely laciniate-fimbriate towards the tip ; seeds 0.7 line long.

54. C. CORNICULATA, n. sp. : caulibus filiformibus crassiusculis ; cymis bracteosis laxis paniculatis seu magis compactis subglobosis ; bracteis membranaceis ovatis obtusis ; floribus pedicellatis ; calycis campanulati ultra medium fissi lobis ovatis carinatis basi imbricatis obtusis seu cuspide nodoso-incrassato obtusato apiculatis subinde patulis recurvisve corollæ tubum æquantibus seu superantibus ; laciniis tubo æquilongis ovato-lanceolatis demum patulis reflexisve apice nodigero seu cucullato corniculatis inflexis ; antheris oblongis filamenta subulata æquantibus ; squamis late ovatis fimbriato-fissis tubum excedentibus incurvis ; stylis ovarium pyriforme æquantibus, stigmatibus magnis pileatis ; capsula corolla marcescente indusiata apice nuda, orificio intrastylari magno ; seminibus oblique ovatis intus carinatis.

Var. *a*. RACEMULOSA : floribus laxe paniculato-cymosis ; calycis lobis apice nodoso acutiusculis. — Southern Brazil, Sellow! 2489 and 3621 in Hb. reg. Berol.

Var. *β*. SPHÆROCYMA : floribus globoso-cymosis ; calycis lobis acutiusculis seu obtusis. — Brazil, Prov. Goyaz, on the campos near the Buixas, Weddell! Venezuela, on the Rio Meta, Karsten !

This is the first of a series of intricate, mostly Brazilian species, which includes nros. 54–58, and which will not be entirely cleared up until carefully studied in their native homes. The inflexed-pointed laciniæ and the naked capsule with the large intrastylar orifice seem to distinguish it sufficiently from *C. racemosa*. Whether both forms described above, which seem to differ so materially in their inflorescence, really do belong together, must be decided after a fuller study of this whole group ; Weddell's specimen seems to connect them. — Flowers 1–1¾ lines long ; cymes of one 5–8 lines, glomerules of the other 4–5 lines in diameter ; seeds of the largest-flowered specimen 0.6–0.7 line long, obliquely ovate, with a very short linear-oblong transverse hilum.

55. C. RACEMOSA, Martius ; spread in several forms over a great part of South America, just like *C. Gronovii* over North America, and *C. planiflora* over Asia and the Mediterranean regions ; it has been introduced with agricultural seeds into Europe, where it has given rise to many discussions, and has, to some extent, stimulated botanists to a further examination of this genus. — All the forms of this species are characterized by the loose racemose-paniculate inflorescence ; calyx usually shorter than the deeply campanulate gradually widening tube ; [505 (55)] laciniæ commonly short, spreading or reflexed with inflexed points ; scales large ; ovarium ovate or obovate, the upper part being compact ; styles stout with large, depressed, almost peltate stigmas ; capsule commonly enveloped by the corolla, with 2–4 light-brown, oval, obliquely truncate or rostrate seeds, 0.6–0.7 line in length ; hilum short, linear, perpendicular or transverse, often with radiating lines on the umbilicus. I distinguish the following forms : —

Var. *α*. BRASILIANA. *C. racemosa*, Martius ! Itin. I. 286 ; Choisy! Cusc. 181, t. 3, f. 1 ; DC. Prod. IX. 456 : flowers with few or scarcely any glands, of a rather membranaceous texture and pale color, with very short and obtuse lobes of calyx and obtusish lobes of corolla ; flowers usually 1½ lines long. — Common about Rio and generally in Brazil, on shrubs and herbaceous plants ; Martius ! 941 ; Booz ! Gaudichaud ! Graham ! Pohl ! 5,100, in part ; Riedel, 695.

Var. *β*. MINIATA. *C. miniata*, Martius ! l. c. ; var. *minuta*, Choisy ! l. c. : flowers of a thicker texture, reddish, more or less glandulous. — Brazil, Martius ! 1292 ; Ackermann ! Mikan ! Langsdorff ! Pohl ! 5,100 in part ; Vauthier ! 252 ; Lund ! 737.

Var. *γ*. CHILIANA. *C. Chilensis*, Bertero! in sched., not Ker. *C. suaveolens*, Seringe, Ann. Sc. Phys. Nat. Lyon, 1840 ; Cl. Gay ! Fl. Chil. IV. 448 ; DesM. Et. 66 (under *Cassutha*, and confounded with *C. obtusiflora*, var. *breviflora*). *C. corymbosa*, Choisy ! Cusc. 180 ; DC. Prod. IX. 456, not Ruiz & Pav. *C. Hassiaca*, Pfeiffer ! Bot. Zeit. 1843, p. 705. *Engelmannia migrans*, Pf. ib. 1845, p. 674. *C. diaphana*, Wend. Fl. Hass. 364. *C. Popayanensis*, Pœppig ! in Hb. Vind. not HBK. — Flowers larger, 1½–2 lines long, more membranaceous ; lobes of corolla with acute inflexed points ; scales as long as or often shorter than the tube. — Chili, Bertero ! 205 in Hb. DC., 940 & 201 in Hb. Shuttleworth (nro. 940 in Hb. DC. is *C. Chilensis*) ; Pœppig ! Cl. Gay ! 449 ; about twenty years ago it was introduced into Europe, but is apparently now lost ; on *Medicago sativa*, sometimes in wet seasons destroying whole fields ; also parasitic on many other plants growing about such fields ; it has been observed in France, Piedmont, Switzerland, Germany, and Holland.

Var. *δ*. CALYCINA. *C. suaveolens*, Lechler ! in sched. : flowers as large as in the last, often glandulous, with longer and obtusish lobes of calyx and corolla, both as long as the short and wide tube ; dead corolla covering the capsule. — Brazil, Sellow ! in Hb. reg. Berol., Weddell ! Riedel ! Valdivia, Lechler ! 479.

Var. *ε*. NUDA. *C. citricola*, Schlecht. Linn. XXII. 808 ? Lobes of glandular calyx ovate, nearly as long

as the tube of the corolla; laciniæ of same length, reflexed, at the obtusish apex inflexed; styles as long as the conic ovary, at last divaricate; lower part of the depressed somewhat glandulous capsule covered by the corolla, upper half free. — Brazil, near Rio, Sellow! 4.99 B.; southern Brazil, the same! in Hb. reg. Berol.; Riedel! 990 in Hb. H. B. Petrop.; Island of Sta. Catarina, southern Brazil, on *Citrus*, Pabst ex Schlechtend. [506 (56)]

56. C. PARVIFLORA, n. sp.: caulibus capillaceo-filiformibus intricatis; cymis fasciculato-paniculatis laxis pauci-floris; pedicellis flore minuto late campanulato longioribus; calycis turbinati lobis ovatis obtusiusculis tubum corollæ æquantibus; laciniis ovatis seu lanceolatis patulis apice obtusiusculo inflexis; staminibus brevibus, antheris ovatis filamenta æquantibus; squamis ovatis laciniato-fimbriatis conniventibus; stylis ovario obovato æquilongis. — *C. micrantha*, Martius! in Hb., not Choisy.

Var. β. ELONGATA: pedicellis elongatis clavatis; floribus minoribus; laciniis acutis tubo subduplo longioribus demum reflexis; filamentis subulatis gracilibus lacinias æquantibus.

Brazil, Minas Geraes, on *Trembleya*, Ackermann! Villa Rica, on some other shrub; Pohl! 5726; Var. β. Goyaz, Weddell! 2125. — Flowers only $\frac{1}{2}$–$\frac{3}{4}$ line long, smaller than in any other species, with the exception perhaps of the smallest forms of *C. Palæstina;* of a deep red color when dry; limb of corolla spreading but not reflexed; fruit unknown. In var. β. the pedicels are two or three times as long as the "whitish" flowers; laciniæ and especially filaments much longer and more slender.

†† Lobes of corolla obtuse, not incurved.

57. C. DENSIFLORA, Hooker, fil.! in Fl. N. Zeal. I. 186, not Soyer-Will. — At Port Underwood, on the middle island of New Zealand, on some *Apocynea*, Dr. Lyall! — Perhaps too near *C. racemosa*, but apparently distinguished by the much finer capillaceous stems, the very short capulate calyx, the short, ovate, obtuse-spreading but not reflexed nor inflexed lobes of the corolla, — which are only about one third as long as the deeply campanulate tube, — and by the solitary globose seeds of a brown-red color, with a short linear transverse hilum on the radiately marked umbilicus. — Flower $1\frac{3}{4}$–2 lines long, dotted with yellow glands, which Dr. Hooker describes as oil-canals; pistils the same as in *C. racemosa;* dead corolla covering and enveloping the capsule.

58. C. MICROSTYLA, n. sp.: caulibus filiformibus floribusque glandulosis; cymulis laxis paucifloris; calycis lobis triangulato-ovatis obtusis corollæ tubo profunde campanulato brevioribus; laciniis ovatis obtusiusculis tubum æquantibus patulis reflexisve; staminibus brevissimis, antheris ovatis filamenta æquantibus; squamis tenuissimis ovatis laciniatis faucem attingentibus; ovario magno ovato-conico tubum replente, stylis subnullis, stigmatibus capitatis pileatis; capsula conica apice e corolla exserta. [507 (57)]

On the volcano of Antuco, Chili, Reynolds! 95, in Hb. Hooker. — The only specimen seen is very young, with only few flowers open, and a single half-grown capsule. — Nearly allied with *C. racemosa*, but well distinguished by the large conic ovary with the thick and rudimentary but nevertheless quite unequal styles; flower $1\frac{1}{4}$–$1\frac{1}{2}$ lines long, thick and fleshy, yellow when dry, dotted with darker glands; whole plant furnishing a deep yellow dye.

59. C. CRISTATA, n. sp.: caulibus filiformibus; floribus breviter pedicellatis cymoso-paniculatis basi obtusis late campanulatis; calycis cupulati lobis ovato-orbiculatis glandulosis cristato-carinatis tubum corollæ æquantibus seu superantibus; laciniis late ovatis obtusis tubo æquilongis, patentibus seu demum recurvis; staminibus brevioribus, antheris oblongis filamenta late subulata æquantibus; squamis imæ corollæ adnatis spatulatis laciniato-fimbriatis faucem excedentibus conniventibus; stylis ovario magno ovato apiculato brevioribus fere inclusis, stigmatibus parvis; capsula depressa glandulosa corollæ marcescenti insidente supra nuda; seminibus obovatis obliquis sub lente rugulosis.

Plentiful in the province of St. Jago de Tucuman, La Plata, Tweedie! 1191, in Hb. Hooker. — Flowers on short and thick pedicels, wide open, about $1\frac{1}{4}$ lines long; ovary large, almost filling the tube, subglobose with an abrupt stylopodium in the shape of a fleshy ring; stigma very small, pale yellowish; capsule with a very small intrastylar aperture; seeds brown-red, 0.7 line long, with an oblong, perpendicular, or oblique hilum. Distinguished by the shape of the flower, the pistils, and stigmas from *C. racemosa*, var. *nuda*, and from *C. Gronovii*, with which it is still more closely allied, and which it seems to represent in South America.

60. C. GRONOVII, Willd.! rel. R. & Sch. VI. 205; Choisy! Cusc. 185, t. 4, f. 3; DC. Prod. IX. 459. *C. Americana*, L. Sp. 180, and auctt Fl. Am. Bor. in part. *C. vulgivaga*, Engelm.! Sill. Journ. l. c. p. 338, t. 6, f. 12–16. *C. umbrosa*, Beyrich! in sched. in part; Hooker! Fl. Bor. Am. II. 78; Torrey! Fl. N. Y. — This, the most common North American species, is characterized by the loosely-paniculate, rarely from the first more compact inflorescence, which at last becomes densely crowded; by the deeply campanulate tube; the obtuse, flat, spreading but scarcely ever reflexed laciniæ; the large, oval, deeply fringed scales; the oval, slightly conic ovary. Seeds 0.6–0.9 line long, obliquely oval, rarely rostrate, with an oblong-linear, usually perpendicular hilum. — The following varieties may be distinguished: — [508 (58)]

Var. *a.* VULGIVAGA, the common form, as described and figured in Sill. Journ. and Chois. Cusc. It is Willdenow's original *C. Gronovii*, in his Hb. nro. 3160, a very loosely flowered specimen. — On coarse herbs and shrubs, commonly in moist shady places, from Canada and Maine to Florida, westward to Missouri, Arkansas, and Texas; I have seen no specimens from the Rocky Mountains or from the Pacific coast. Flowers $1\frac{1}{4}$–$1\frac{1}{2}$ lines long; lobes of calyx usually carinate, and, like the laciniæ, shorter than the very deeply campanulate tube of the corolla; scales mostly shorter than the tube, incurved over the ovary; corolla remaining at base of capsule. Variable in the size of the flowers; a small-flowered form is *C. polyantha*, Shuttlew.! in Pl. Rugel from Alabama; sometimes it occurs with 4-parted flowers, var. *tetrameris*, Engelm. l. c.

Var. *β.* LATIFLORA. *C. Saururi*, Engelm.! l. c. p. 336, t. 6, f. 17–21: calyx more membranaceous; laciniæ and stamens of equal length, as long as the shallow tube; scales narrow and longer than the tube; in eastern specimens the flowers are smaller, in western sometimes larger than in var. *a.* — From Massachusetts to North Carolina, and westward to Illinois and Missouri.

Var. *γ.* CALYPTRATA. *C. Bonariensis*, H. B. Carlsr. *C. Chilensis*, H. B. Frib., not Ker.; similar to the first form, flowers even more deeply campanulate, usually glandulous, rather larger, in very loose panicles; corolla remaining on top of capsule. — Western Louisiana, Gregg! Texas, Lindheimer! cultivated in several botanical gardens in Germany.

Var. *δ.* ? CURTA. *C. umbrosa*, Hook. l. c. in part: flowers small, $1\frac{1}{4}$ lines long, glandulous; calyx and short broadly-oval laciniæ half as long as the deeply campanulate tube; anthers triangular-cordate; scales very short, bifid or truncate, appressed to the tube; styles one third or one fourth as long as the conic ovary; corolla surrounding or covering the upper part of the large oval capsule; intrastylar opening large; seeds few and large, nearly 1 line long, compressed, somewhat rostrate, with a small, oblong, transverse hilum. — Northwestern America, Douglas! Fremont! 79 (1845). — Perhaps a distinct species, taking the place of *C. Gronovii* on the Pacific side of the continent.

61. C. ROSTRATA, Shuttlew.! in sched.; Engelm.! in Bost. Journ. N. H. V. 225. *C. oxycarpa*, Engelm.! in sched. — In shady woods, on tall coarse herbs, rarely on shrubs, southern Alleghanies from [509 (59)] Maryland and Virginia to South Carolina, Rugel! Buckley! Gray & Sullivant! Curtis! — Nearly allied with the last, but flowers larger and wider, 2–3 lines long; scales comparatively small, deeply incised-fringed; ovary elongated, bottle-shaped; capsule, with the elongated 2-pointed beak, $2\frac{1}{2}$–3 lines long; seeds 1–4, when regularly developed 1–$1\frac{1}{4}$ lines long, obliquely obovate, compressed, carinate on the inside, bluntly rostrate, somewhat reticulate, with a short oblong-linear mostly transverse hilum.

§ 3. Lepidanche.

Flowers pedicelled or, mostly, closely sessile; sepals free, similar to the surrounding sterile bracts, imbricate; ovary and capsule more or less conic, thickened and fleshy at the apex; withered corolla covering the capsule like a hood. — *Lepidanche*, Eng. Sill. Journ. XLIII. p. 343.

* Flowers pedicelled, loosely paniculate.

62. C. CUSPIDATA, Engelm.! in Bost. Journ. N. H. V. p. 224; Bot. Zeit. 1846, p. 277. — Parasitic on *Iva*, *Ambrosia* and many other herbs, on wet or dry prairies from southern and western Texas, Lindheimer! 125 and 277, Wright! Schott! Thurber! to the upper Arkansas, Trécul! Fendler! N. Mex. 659, b; Marcy! Bigelow! and to the sandhills of the Platte, Hayden! — A well-marked and easily recognized species; inflorescence loosely paniculate, with many sterile hyaline bracts on the pedicels and at the base of the calyx; flowers membranaceous, $1\frac{1}{2}$–$2\frac{1}{4}$ (mostly 2) lines long; upper bracts and sepals ovate or orbicular, cuspidate or sometimes obtuse; ovary not globose, as I formerly described it, but oval, with a thick stylopodium; capsule thick and glandulous at the apex; seeds rarely more than 0.4 line long, obovate, compressed, rostrate, with a very short oval mostly transverse hilum. The form from Platte river has the smallest flowers, and almost orbicular sepals.

63. C. BRACTEATA, n. sp.: caulibus tenuiter filiformibus; cymis spiciformibus paniculatis; pedunculis pedicellisque crassis bracteis pluribus ovatis obtusis, superioribus lanceolatis acutatis stipatis; sepalis similibus longioribus acuminatis serrulatis tubum corollæ subcylindricum æquantibus; laciniis lanceolatis acuminatis tubo brevioribus reflexis; staminibus multo brevioribus, antheris oblongo-ovatis filamento æquilongis; squamis ovatis crispato-laceris medio tubo adnatis faucem attingentibus; stylis capillaceis ovario minuto multo longioribus inclusis, stigmatibus ovato-capitatis.

Goyaz, Brazil, parasitic on shrubs, Gardner! 3348 in Hb. Hooker. — Similar to the last, but flowers much larger, $2\frac{1}{2}$–3 lines long in a rather contracted inflorescence; peduncles remarkably thick in proportion [510 (60)] to the stems; stigmata oval, almost twice as long as they are thick, a form that I have not seen in any other species. The only specimen examined is barely in flower; the ovary is probably shaped as in the last species.

* * Flowers closely sessile, crowded in compact and often continuous clusters.

64. C. SQUAMATA, n. sp.: caulibus filiformibus aurantiacis; glomerulis compactis; bracteis 2–5 sub flore sin-

gulo arcte sessili late ovatis cuspidatis membranaceis adpressis sensim in sepala exteriora similia et interiora longiora obtusiora tubum cylindraceo-obconicum æquantia transeuntibus; staminibus brevioribus, antheris oblongo-linearibus filamenta subulata æquantibus; squamis ovatis laciniato-fimbriatis medio tubo adnatis faucem excedentibus conniventibus; stylis capillaceis ovario ovato-conico multo longioribus exsertis; capsula ovata apiculata 1–2-sperma corollæ rudimentis calyptrata; seminibus subglobosis lenticularibusve, hilo oblongo abbreviato.

Fields and wastes on the Rio Grande, on *Artemisia Ludoviciana*, *Helianthus ciliatus* and other weeds, from El Paso, Wright! 518 (coll. 1849) and 1628 (coll. 1852), Bigelow! Thurber! down to Presidio del Norte, Parry! — Clusters 5–6 lines in diameter, consisting of 8–12 flowers; or sometimes small, only 2–3-flowered; occasionally continuous, in the manner of the next species; flowers 2½ lines long, similar in shape to those of the two last species, but closely sessile, in other respects much like the next, but bracts appressed, not squarrose. Seeds 0.6–0.7 line long; subglobose when the capsule has only 1 seed, compressed when it contains 2, oblique but scarcely rostrate, with a very short oblique or transverse hilum, almost a mere dot.

65. C. GLOMERATA, Choisy! Cusc. 184, t. 4, f. 1; DC. Prod. IX. 458. *Lepidanche Compositarum*, Engelm.! Sill. Journ. XLIII. p. 344, t. 6, f. 30–35. *C. Americana* (*monstruosa*), Hook. in Comp. Bot. Mag. I. 173. *C. paradoxa*, Rafin. Ann. Nat. 1820, p. 13, & DC. l. c. 461? — Prairie regions of central North America, on *Helianthus*, *Solidago*, *Vernonia*, *Silphium* and other tall *Compositæ*; rarely parasitic on any other plant: from Indiana, Dr. Clapp! to Illinois and Missouri, Drummond! Engelm.! Riehl! 15 & 16; Kansas, Hayden! the upper Arkansas region, Fendler! 657; southward to the Canadian, Bigelow! and to the Liano in western Texas, Lindheimer! Mr. Riehl found it very destructive to the pear seedlings in his nursery. — This, the most striking of all *Cuscutæ*, has been so fully described, that very little is to be added. The glomerules almost always form two parallel lines on both sides of the [511 (61)] stem, wherever it is attached to the stem of the nurse and somewhat flattened, rarely in detached clusters, where the stem is free; these clusters of flowers run completely together and form at last a continuous spiral coil, 6–10 lines in thickness, and several inches in length; the orange-red filiform stems have by this time entirely disappeared. — Flowers 2½–3 lines long, surrounded by numerous squarrose bracts; lobes of corolla obtuse, not acute; stylopodium larger (Sill. J. l. c. f. 33), or smaller (l. c. f. 34) than ovary proper; flowers often sterile; seeds 2 or mostly 1 in each capsule, 0.5 line long, oval, more or less compressed, very slightly rostrate, small oval hilum transverse.

Rafinesque was no doubt the first to distinguish this species, and his name, a very appropriate one, would have the precedence over the later ones, if he, by his very incorrect description, had not enveloped the whole in so much obscurity, that Choisy's later name is to be preferred.

66. C. COMPACTA, Jussieu! in Hb.; Choisy! Cusc. 185, t. 4, f. 2; DC. Prod. IX. 458; Engelm.! Bost. Journ. N. Hist. V. 225. *C. remotiflora* and *C. Fruticum*, Bertol. Misc. bot. X. 29. *C. Americana*, auct. var. *C. imbricata*, Nutt.! in Hb. *C. coronata*, Beyr.! in Hb. — From the banks of the St. Lawrence in the State of New York southward, and on the Alleghany mountains from Pennsylvania to Georgia and Alabama, almost entirely on shrubs, such as *Corylus*, *Alnus*, *Andromeda*, etc.; only accidentally on herbaceous plants. — Clusters in fruit often ¾–1½ inches in diameter, continuous and thickest where the stem is twined around the nurse, but also abundant where it is free; tube of corolla slender, laciniæ oblong; dead corolla raised on top of the acutish capsule, giving it a pointed appearance; seeds 1–2, rarely 3–4, in each capsule, 0.8–1.0 line long, oval oblique, lenticular or carinate inside, scarcely rostrate; hilum small, oblong, perpendicular or transverse.

Var. β. ADPRESSA. *Lepidanche adpressa*, Engelm.! in Sill. Journ. XLV. p. 77. *C. acaulis*, Raf. Ann. Nat. 1820, p. 13? — Shady woods in rich bottom-lands along streams in the Mississippi valley, on *Cephalanthus*, *Cornus*, *Salix*, *Bignonia*, *Vitis*, *Rhus Toxicodendron*, *Smilax*, and some herbaceous plants; western Virginia to Illinois and Missouri, and southward to western Louisiana and Texas. — Tube of corolla wider, more deeply immersed in the calyx, lobes broader, capsule thicker, not so much pointed, and corolla not so much raised above it, so that the clusters, especially in fruit, appear more obtuse; seeds of same size as in α., usually 2–4 in a capsule, compressed, scarcely carinate, with a longer, transverse hilum. The difference in the seeds appears to be constant, and proves [512 (62)] again that in this genus not much reliance can be put on characters derived from them.

SECT. 7. LOBOSTIGMA.

Styles of nearly equal length, clavate towards the flattened stigmatose top, which is divided into several unequal orbicular lobes, and depressed in the centre; capsule baccate.

Inflorescence a loose fasciculate cyme, bracts at the base of the long pedicels; corolla enveloping and covering the capsule.

The only species of this section is a native of Tasmania.

67. C. TASMANICA, n. sp.: caulibus capillaceis; cymis laxifloris umbellato-fasciculatis compositis; pedicellis elongatis clavatis in calycem turbinatum profunde fissum abeuntibus; floribus glandulosis; lobis calycis oblongis obtusis tubum æquantibus; laciniis oblongis obtusis patulis seu demum reflexis tubo longioribus; staminibus

brevioribus conniventibus, antheris oblongo-linearibus filamento crasso longioribus ; squamis angustis apice fimbriato bifidis faucem æquantibus ; stylis ovario subgloboso fere longioribus exsertis. — *C. australis*, Hook. fil.! Fl. Tasm. 278, not R. Br.

Hobartstown, Tasmania, Gunn! 1991, in Hb. Hooker. — Well characterized and distinguished from any other species by the shape of the stigma. Fascicles of 4–8 flowers aggregated in larger cymes ; flowers $1\frac{1}{2}$–$1\frac{3}{4}$ lines long, usually 5-parted ; anthers turned inward, with a very broad commissure on the back ; scales crenulate on the sides, deeply fringed and usually bilobed at the tip ; styles nearly as long as lobes of corolla, much longer than the stamens ; stigma commonly with four unequal lobes ; styles in fruit subulate from a broad divaricate base, distant, with a small aperture between them ; no ripe seeds seen.

Sect. 8. MONOGYNELLA.

Styles united entirely or for the greater part of their length, thick and compressed ; stigmata capitate, subglobose or ovate, distinct or more or less coalescent. Capsule regularly circumscissile, usually 2-seeded ; dissepiment of the shape of the capsule, transparent, with a thicker rim, entire, no part adhering to the base of the style. Seeds compressed, oblique, more or less rostrate, with a long linear transverse hilum. Anthers sessile, or on very short filaments, often attached to the tube below the throat.

Stems thick ; flowers comparatively small, always 5-parted, sessile or on short pedicels, supported by bracts, in small cymules, which form a compound spike or raceme ; withered corolla remaining, hoodlike, [513 (63)] on the very top of the large capsule.

Parasitic mostly on ligneous plants. Of the eight species of this section, five belong to the continent of Asia, two of which extend into Europe ; one is peculiar to the island of Timor, one to South Africa, and one to Texas.

68. C. EXALTATA, n. sp.: caule funiculari ; floribus breviter pedicellatis seu sessilibus spicato-paniculatis ; calycis globosi lobis fere disjunctis orbiculatis concavis imbricatis medio verrucosis corollæ tubum cylindricum æquantibus ; laciniis orbiculatis imbricatis tubo multo brevioribus erectis seu erecto-patulis ; antheris cordato-orbiculatis ad faucem sessilibus ; squamis bipartitis dentatis tubo multo brevioribus ; stylo apice bifido ovario ovato-globoso æquilongo, stigmatibus subglobosis.

Parasitic on *Diospyros Mexicana*, *Ulmus crassifolia*, *Quercus virens*, *Juglans*, *Rhus*, etc., 10–20 feet high, in western Texas, on the Guadaloupe and Cibolo, Lindheimer! 472 ; on the Colorado and Blanco, Wright! on the Leona and at the mouth of the Pecos, Bigelow! on the Rio Grande, Schott! — Stems 1–2 lines in diameter ; compound panicles several inches in length ; flowers 2 lines long, small tube hidden in the large calyx ; anthers closely sessile ; scales reduced to two dentate wings on the sides of the very distinct attached filaments, united at base ; upper fourth of the thick style divided ; stigmas depressed, thicker than the ends of the style ; capsule $3\frac{1}{2}$–5 lines long ; seeds $1\frac{1}{2}$–$1\frac{3}{4}$ lines long, somewhat triangular, very slightly rostrate. The large embryo is coiled up in 2–3 rounds ; on the upper (thinner) end 3–4 alternate scales may be distinguished. This is the only species of this section where the styles are not completely united. I formerly distributed it under the name of *C. gamostyla*.

69. C. CASSYTOIDES, Nees ab Esenb.! in Linnæa, XX. p. 196, sine descr.: caule funiculari ; floribus subsessilibus cymoso-spicatis ; calycis globosi lobis orbiculatis concavis imbricatis verrucosis corollæ tubum latum breviter cylindricum includentibus ; laciniis ovatis obtusis vix basi imbricatis erectis tubum æquantibus ; antheris cordato-ovatis ad faucem sessilibus ; squamis tenuissimis apice truncato pauci-dentatis tubo brevioribus ; stylo ovario ovato-conico æquilongis, stigmate capitato bilobo ; capsula ovata ; seminibus ovato-triangulatis tenuiter verruculosis.

Cape of Good Hope ; primitive forests of Uitehage, Drege, 8037 ; Hangklipp, Mund & Maire ; Zeyher II. 3631 (120.5). — Flowers in spiked cymules, $1\frac{3}{4}$ lines long, shorter than in the last species ; [514 (64)] scales united at base, ovate obtuse or truncate, scarcely dentate ; styles united entirely ; stigma divided almost to the base, lobes subglobose ; capsule 3–4 lines long, subglobose ; seeds of the same size and shape as in the last species.

70. C. TIMORENSIS, Decaisne! mss.: caule funiculari ; floribus racemoso-spicatis seu axi indeterminata apice bracteata spicatis ; pedicellis inferioribus longioribus bracteatis, superioribus brevissimis nudis, omnibus bractea ovato-orbiculata concava suffultis ; calycis profunde partiti lobis orbiculatis concavis imbricatis tubum corollæ brevem campanulatum æquantibus ; laciniis ovatis obtusis tubo brevioribus erectis seu sæpe patulis reflexisve ; antheris cordato-ovatis tubo infra faucem adnatis ; squamis ad cristulas binas convergentes reductis seu subnullis ; stylo cum stigmatibus ovatis compressis ovarium subglobosum æquante ; capsula ovata conica sub-2-sperma ; seminibus orbiculato-triangulatis compressis. — *C. reflexa*, Dne.! in Hb. Timor. descr. p. 66, not Roxb.

Island of Timor, Leschenault! in Hb. Mus. Par. — The tendency to a regularly spiked inflorescence, which is observed in this whole group, is more decidedly developed in this species. The main axis of the inflorescence is terminated by an imbricately bracted bud, never by a flower. The lower lateral flowers open first, and the upper ones in succession ; all, or only the lower ones, are supported by pedicels bearing lateral flowers ; the upper ones often have

shorter pedicels, with two or three sterile bracts; the uppermost ones are commonly quite short and bractless. Flowers 1½–1¾ lines long; anthers almost sessile a little below the throat; scales very indistinct, consisting mostly of two slight ridges converging towards the base of each anther; stigmas of the length of the style and scarcely thicker, oval and compressed; capsule about 3 lines long; seeds 1¼ lines in diameter.

71. C. MONOGYNA, Vahl. Symb. II. 32; DC. Prod. IX. 450, & auctt. in part. *C. orientalis*, Tournef.! Cor. 45; Sibth.! in Hb. Jacq. *C. astyla*, Engelm.! Bot. Zeit. 1846, IV. 276. *Monogynella Vahliana*, DesM.! Et. 65. *C. scandens*, Brot. Lusit. I. 208 ?? — On shrubs and trees, as *Salix*, *Tamarix*, *Pistacia*, *Vitis*, etc.; also on herbaceous plants, *Euphorbia*, etc.; from southern Europe through middle Asia southeastward: Portugal (?Brot.); southern France, almost always on the grape vine (introduced?), Delisle! Requien! etc.; Roumelia, Frivaldski! specimens often mixed with *C. Europæa;* Crimea, Trautvetter; Greece, Heldreich! Orphanides! Asia Minor, Sibthorp! Wiedemann! Syria, Tournefort! in Hb. Banks, Labillardière! Blanche! Caucasus and Georgia, Hohenacker! Prescott! Wilhelms! Frick! Koch! Soongaria, Schrenk! Persia, Buhse! Noë! Kotschy! 713; Afghanistan, [515 (65)] Griffith! 682 & 684. — Vahl's description, "dentibus corollæ lanceolatis," etc., does not exactly agree with our plant, nor is Sibthorp's figure, Fl. Græc. t. 257, very correct; but the locality of the former and an authentic specimen of the latter (in Hb. Jacq.) leave no doubt that both had the plant in view which I formerly distinguished as *C. astyla*. — The inflorescence is a compound spike, consisting of a terminal and several lateral cymes of 2–3 or 4 sessile flowers; the lowest cymes open first, and are sometimes branched. Flowers 1¼–1½ lines long; corolla 1–1¼ lines in length; laciniæ oval or orbicular, very obtuse, delicately crenulate, erect, scarcely more than half as long as the tube, which is entirely enclosed in the calyx; anthers ovate or triangular-ovate, cordate at base, almost sessile a little below the throat; scales attached to the middle of the tube, of the shape of a horseshoe, forming a narrow denticulate or slightly fimbriate border, which is sometimes truncate or even bifid; style very short, equal in length to the subglobose 2-lobed stigma, much shorter than the oval or globose ovary; capsule 2–3 lines long, usually oval and obtuse; seeds rarely more than 2, ovate, strongly rostrate, slightly rough. — *Mon. Blancheana*, DesM.! in litt. is a form with a somewhat elongated conic capsule, which occurs in Syria and Georgia, and which approaches the next species.

72. C. LEHMANNIANA, Bunge! in Lehm. Rel. in Mem. Sav. Ét. VII. 396. — Bokhara, on the banks of the Jan-Darja, A. Lehmann! — Flowers pedicelled in a thyrsoid inflorescence, slender, 2½–2¾ lines long; corolla 2–2¼ lines in length; laciniæ oval, crenulate, shorter than the tube, erect or spreading; scales horseshoe-shaped, attached to the middle of the tube, and covering the base of the ovate-cordate anthers, which are sessile below the throat; style much shorter than the oval or subglobose ovary, of the length of the distinctly 2-parted oval stigma; capsule oval. The shape and proportion of the corolla is similar to that of the next species, especially of its Asiatic form; the pistil is like that of the last species; the position of scales is quite peculiar. I class with this a form from Asia Minor:

Var. *β*. ESQUAMATA: pedicels as long as, or often longer, than the calyx; oblong lobes of the corolla still more distinctly crenate, not much shorter than the tube, spreading, on the fruit erect or twisted; anthers still shorter; scales almost entirely adnate, commonly showing only a denticulate crest on both sides; stigma globose or oval, almost sessile. — On *Pistacia Terebinthus*, on Mount Sipyle, near Magnesia, Balansa! 411. — Flowers 2½ lines, corolla 2 lines long, more deeply divided than in the allied species.

73. C. LUPULIFORMIS, Krocker! Siles. I. p. 261, t. 36. *C. monogyna*, auctt. Fl. Germ. al. — [516 (66)] On willows, etc., on the banks of streams from eastern and northeastern Germany, Silesia, where it seems to be common on the Oder, Lessing! Göppert! Günther! al., Bohemia and Austria, Kovats! to Hungary, Gerenday! and to central Russia, Kasan, Graff! — Flowers subsessile, or on at last slightly elongated pedicels; cymes forming elongated spikes, or sometimes more or less compound racemes, which are always terminated by a 2- or 3-flowered cyme; flowers 2–2½ lines long; lobes of calyx oval, obtuse or almost pointed, half as long as tube of corolla; laciniæ oblong, obtuse, erect, half as long as tube; anthers oblong-linear, sessile below the throat; scales short, attached to the lower part of the tube, bifid or reduced to lateral crenulate wings; ovary oval, conic, attenuated into the slender style, which is much longer than the globose or oval deeply bilobed stigma. Capsule conic, 3–4 lines long; seeds triangular-oval, rostrate, 1¼–1½ lines long.

Var. *β*. ASIATICA: flowers often longer and more slender, on longer pedicels; laciniæ more crenulate and somewhat spreading; anthers on short but distinct filaments; scales entire, broadly oval, fimbriate and somewhat incurved. *C. flava*, Siev. ap. Pall. probably belongs here. — On *Tamarix*, *Salix*, etc., from the banks of the Wolga, Fischer! Becker! where it seems to join the western form, eastward through the southern parts of Asiatic Russia, Caucasus, Hb. Hooker! Soongaria, Schrenk! 229 & 306, b (the last a form with very slender flowers and longish pedicels); Buchtarminsk, Karelin & Kiriloff! 926; Altai, Ledebour! Bunge! Gebler! 180, to the river Angara, Turczaninoff!

C. lupuliformis, having been published as early as 1787, has by four years the priority over Vahl's name, *C. monogyna*, published in 1791, and must stand for the species with all those botanists who consider both plants as identical; but it so happens that *C. lupuliformis* properly designates the species which in Europe and Asia extends north of the 43d or 44th degree, and *C. monogyna* that which grows south of that latitude.

74. C. GIGANTEA, Griffith, Notul. I. 243. — On *Tamarix*, Siah-sung ravine, Afghanistan, 10,300 feet high, Griffith! 1031 (683). — Griffith's specimens corresponding best with his description are all parasitic on *Tamarix*, and not on *Salix* or *Populus*, as he says in his Notulæ; nor are the stems very thick, but rather filiform. Otherwise his detailed description — especially that of the corolla, the scales, and the stigmas — agrees so well with his specimen in question, that I cannot doubt about his having it in view; but he may have confounded it [517 (67)] with *C. monogyna*, which he has collected on willows.

The inflorescence forms racemose spikes after the manner of this section, but shorter, only ½–¾ inch long, flowers 2½–2¾ lines long, membranaceous, on short pedicels; calyx covering one half of the tube; laciniæ linear-oblong, obtuse, crenulate, a little shorter than the tube, spreading, or reflexed; ovate-cordate anthers very large, subsessile a little below the throat; scales oval, fimbriate, reaching from the base to the middle of the tube; style as long as the conic ovary and the oblong, elongated, somewhat ligulate (linguiformia, Griff.) stigmas.

75. C. JAPONICA, Choisy! Pl. Zoll., 1854, p. 130 & Pl. Jav. 1858, p. 30. — This species extends in several forms along the whole coast of China and to Japan; all the different varieties are characterized by a very short cupulate calyx, with rounded, mostly cristate lobes, which cover scarcely more than ¼ of the corolla; by the oval or rounded, very slightly crenulate, sometimes cuspidate, spreading or reflexed laciniæ, which have ½ or ⅓ the length of the cylindrical or slightly widening tube; by the oval anthers, sessile or subsessile at the throat; by the entire, ovate, fimbriate, incurved scales; by the elongated style, with 2 ovate, more or less conic or subulate, stigmas. Flowers 2½–3 lines long.

Var. *a*. THYRSOIDEA: flowers subsessile with several bracts at base, in a compact, thyrsoid raceme, often 2 inches long and ½ inch thick; scales from the lower part of the tube, reaching almost to the base of the anthers; styles longer than the conic ovary; stigmas short and conic. — This is Choisy's original *C. Japonica*, and also *C. reflexa*, var. *densiflora*, Bentham! in Hb. — Japan, Zollinger! 355; Hongkong, Abbé Furet! Maj. Champion! 457. — *C. systyla*, Maximowitsch! Primit. Fl. Amur. ined., from the lower Amur, is exactly the same plant, with shorter scales, and rather oval than conic stigmas. From *C. lupuliformis*, var. *Asiatica*, to which it closely approaches, it is distinguished by the short calyx and the shape and insertion of the stamens.

Var. *β*. PANICULATA: flowers on short pedicels, scarcely bracted at base, in a loosely flowered panicle, 1–2 inches long and of the same diameter; narrow scales reaching from the base to the middle of the tube; stigmas conic-subulate, as long as style and as ovary. — *C. colorans*, Maxim.! l. c. — Pekin, Kirilow! in Hb. Fischer, now Hb. H. B. Petrop.

Var. *γ*. ? FISSISTYLA: inflorescence same as last; scales from the middle of the tube, not reaching the base of the anthers, broad and often partly confluent; styles united only at their lower third; stigmas conic. — Hongkong, Chas. Wright! U. S. North Pacif. Expl. Exp., nro. 486.

The subulate or conic stigmas, and the often more paniculate than spiked inflorescence, indicate a [518 (68)] close approach to the next species, which to Mr. Bentham was so evident, that he considered our plant a mere variety of it; but the structure of the capsule, with the corolla persisting on its top and the dissepiment in its base, shows that it truly belongs to *Monogynella*. The dissepiment is membranaceous, with a thicker centre, but without the thick frame-like border of the allied species.

SECT. 9. CALLIANCHE.

Stigmata distinct, elongated, conic or subulate, sessile or almost sessile. Capsule regularly circumscissile, usually 4-seeded, dissepiment extremely thin, partly evanescent, stylar portion small. Seeds compressed, rostrate, angled on the inside, with a long, linear, transverse hilum.

Flowers large, 5-parted, usually on bracted pedicels in compound loosely paniculate cymules; corolla deciduous after flowering. The only species inhabits East-India and the adjoining islands.

76. C. REFLEXA, Roxb. Corom. 104; Fl. Ind. I. 446. — This beautiful species bears the largest flowers of any, in different varieties from 3–5 lines long; calyx with oval or mostly rounded, very often cristate or verrucose lobes, much shorter than the cylindric tube of the corolla; laciniæ spreading or reflexed, on the margin revolute, much shorter than the tube; anthers oval to oblong-linear, sessile or subsessile; scales in the base of the tube, about ½ or ⅓ its length, with short and delicate curly fringes, curved; ovary oval, acutish, often attenuated into a short, slightly bifid style, or with sessile stigmas; capsule subglobose, about 4 lines in diameter; at maturity, only the lowest part of the thin dissepiment remains; seeds 1½ lines long. — The following forms are specifically distinguished by most authors; Choisy, however, in Pl. Zoll. already suspected their identity, and different as they seem to be at first sight, I can not but consider them as mere varieties.

Var. *a*. GRANDIFLORA. *C. grandiflora*, Wall.! Cat. nro. 1318, not HBK. *C. macrantha*, Don.! Gen. Syst. IV.

305; DC. Prod. IX. 455. *C. megalantha*, Steud. Nom. *C. elatior*, Choisy! Cusc. 177. — Flowers of the largest size; laciniæ ⅓ or sometimes only ¼ the length of the tube; anthers elongated, on very short filaments separating from the tube below the throat; stigmas elongate, subulate, divaricate, usually on a very short style. This is no doubt Roxburgh's original *C. reflexa*, as his figure and description, "stigmata large, spreading, pointed," [519 (69)] prove. — In the temperate as well as the tropical parts of India, from the Himalaya, Wallich! 1318 & 1319 [2]; Lady Dalhousie! Jacquemont! 1109 & 2183; Strachney & Winterbottom! 1 & 2; Hofmeister! Hooker, f. & Thomson! Sikkim, the same! Khasia, the same! to the low lands of the coast of Coromandel, Roxburgh, and to Ceylon, Gardner! 616; Thomson! and Java, Zollinger! 2839. — The specimens from the islands are remarkably stout, and have a larger calyx than the ordinary form. It often occurs with verrucose bracts, pedicels, and calyx or even verrucose stems; this is *C. verrucosa*, Sweet, Fl. Gard. t. 6, not Engelm.; *C. Hookeri*, Sweet, Hort. Br. p. 290; *C. reflexa*, var. *verrucosa*, Hook.! Fl. Exot. t. 150.

Var. β. BRACHYSTIGMA. *C. reflexa*, Wallich! Cat. in part; Edgeworth! in Linn. Trans.; Choisy, DC. Prod. l. c.; and most authors, not Roxb. *C. pentandra*, Heyne! in Hb. H. B. Petrop. — Flowers smaller; laciniæ ½ or ⅓ the length of the tube; anthers shorter, sessile at the throat of the corolla; stigmas short, conic, closely sessile, erect. — Calcutta, Gaudichaud! 129, and valley of the Ganges in general, Jacquemont! 149 & 2520, de Silva! in Wall. Cat. 1319 [1], to the Punjab and the western Himalaya, Hooker, f. & Thomson!

Jacquemont's 149, from Bengal, has the corolla and anthers of var. α., and the short erect stigmas of var. β.; style distinct, almost as long as the stigmas.

C. anguina, Edgeworth! Trans. Linn. Soc. XX. 86, from the Himalaya, is a small-flowered form with more deeply divided tube, otherwise the same as var. β.

C. aphylla, Raf. in Spr. N. Ent. I. 145, and DC. Prod. IX. 461, from the Wabash, is perhaps the same as *C. glomerata*.

C. Epibotrys, *Uva barbata* or *Ampelepogon*, is the name given to the numerous capillary stems of a *Cuscuta* which occasionally have been found parasitic on the unripe berries of the grape vine; they often seem to be without flowers; in one instance they have been ascertained to belong to *C. Epithymum*.

C. subuniflora, Koch, in Linnæa XXII. 748, from Asia Minor, I have not seen; it may be a depauperate form of *C. brevistyla*.

C. triflora, E. Mey. in Pl. Drege, from the Cape of Good Hope, is, as well as *C. funiformis*, Willd., a species of *Cassyta*.

VI. COLLECTED DESCRIPTIONS OF CUSCUTA.

[It has been thought best not to reproduce the accounts of this genus contributed by Dr. Engelmann to Gray's Manual, ed. 5; Botany of California, I.; Botany of Wheeler's Expedition, 1878; and Gray's Synoptical Flora of North America, II. part 1, — as they add little to his earlier papers. But descriptions of new species contained in them are included in the following pages. — Eds.]

From Engelmann and Gray's Plantæ Lindheimerianæ. (Boston Journ. Nat. Hist. Vol. V. 1845.)

123. Cuscuta neuropetala, Engelm. in Sill. Journ. XLV. p. 75, β. minor. A smaller, earlier [223 (15)] flowering form, growing in drier places, mostly on *Petalostemon multiflorum*, but also on *Liatris*, and even on *Euphorbia corollata*. It approaches *C. hispidula* so much that not improbably further investigation of living plants may prove both to be only varieties of a single species, for which the name of *C. porphyrostigma* would be most appropriate, as all the forms that would belong to it are distinguished from every other known North American species by the purplish-brown stigmas. Another remarkable variety is

124. C. neuropetala, Engelm. γ. littoralis: cymis paniculatis; floribus majoribus pedunculatis; tubo corollæ late campanulato calycis segmenta late ovata acutiuscula subcarinata et lacinias limbi enervias ovatas abrupte acuminatas crenulatas patentes subæquante; squamis tubum subæquantibus. — Seashore of Galveston Island, on *Lycium Carolinianum*, *Borrichia frutescens*, *Iva frutescens*, etc. Flowers in May. Different from the inland form by the much larger, more openly campanulate flowers, expanding in spring; by the hardly carinate, broader, and not so

acute sepals, and the broad lobes of the corolla, which are rarely somewhat nerved; stigmata also purple, [224 (16)] and anthers purple or yellow.

125. C. CUSPIDATA, Engelm. n. sp.: caule filiformi ramosissimo; floribus pedunculatis in cymas laxas bracteosas dispositis 5-fidis; tubo corollæ cylindrico sepala usque ad basin libera ovata concava (exteriora cuspidata) et lacinias limbi ovatas acutiusculas uninervias erectas s. patentes superante; staminibus limbo brevioribus; squamis ovatis fimbriatis tubum subæquantibus; stylis filiformibus ovario (minuto) globoso pluries longioribus; capsula globosa corolla marcescente obtecta.

Var. *a.* PRATENSIS: floribus minoribus; calyce bracteis paucis involucrato; tubo corollæ subcylindrico calycis et corollæ segmentibus paulo longiore; staminibus limbi laciniis ovatis acutiusculis duplo brevioribus; stylis ovarium parvum duplo superantibus. — Dry prairies west of the Brazos, on *Tephrosia*, *Bradburia*, *Ambrosia*, etc. June.

Var. *β.* HUMIDA: floribus majoribus; calyce bracteis pluribus involucrato; tubo corollæ infundibuliformi calycis et corollæ segmenta duplo superante; staminibus laciniis limbi lanceolatis acutis paulo brevioribus; stylis ovarium minutum quater superantibus. Bottom lands of the Colorado, on *Iva ciliata*, *Ambrosia trifida*, etc. August, 1844 (No. 276 infra).

A remarkable species. The stems are very much branched, filiform; inflorescence loose paniculate, pedicels with many cuspidate bracts, some of them surrounding the calyx like an involucrum, similar in shape but smaller than the sepals; sepals somewhat lacerate or crenulate, ovate, carinate (the carina less distinct in the var. *β.*), cuspidate, interior ones rather obtuse, all concave, loosely imbricated. Lobes of corolla thin, membranaceous, with a strong middle nerve, formed by large oblong or linear cells; when dry, convolute; the exterior ones generally somewhat cuspidate, the interior ones obtuse; at the base the lobes are dilated and cover one another more than in any other North American species. Styles remarkably slender and long, about the length of the stamens, but elongated after flowering, when the corolla assumes an urceolate shape, and finally covers like a hood [225 (17)] the upper part of the globose capsule. — It appears to be an intermediate form between *Cuscuta* proper and *Lepidanche*. The var. *β.* has larger and thinner flowers, of paler color, and the lobes of the corolla lanceolate and acute.

126. C. PENTAGONA, *β.* CALYCINA, Engelm. Wet prairies. June.

127. C. VERRUCOSA, Engelm., l. c. Dry prairies. July.[1]

[1] An undescribed North American species, collected in the Alleghanies of Virginia and North Carolina by Dr. Gray and Mr. Sullivant, in the autumn of 1843, is here appended. (This was named *C. oxycarpa*, n. sp.; but just as these sheets are going to press, Dr. Engelmann writes that Mr. Shuttleworth has distributed the same plant from Rugel's collection, with a printed label, under the name of *C. rostrata*, which he therefore now substitutes for his own. — A. GR.)

C. ROSTRATA, *Shuttlew. in coll. Rugel:* caule ramoso; floribus pedunculatis cymoso-umbellatis 5-partitis; tubo corollæ globoso-campanulato calycis segmenta ovata obtusa leviter crenulata et lacinias limbi ovatas obtusas patentes (demum reflexas) duplo superante; staminibus limbum subæquantibus; squamis fimbriatis (convergentibus?) basi inter se connatis; stylis filiformibus ovarium stylopodio ejusdem longitudinis coronatum pyriforme subæquantibus; corolla marcescente ad basin capsulæ (maximæ) acutatæ persistente. — Alleghany Mountains from Virginia to South Carolina (*Mr. Buckley!* 1842), *Prof. Gray* and *Mr. Sullivant!* 1843. — August to October. — Particular localities recorded by Messrs. Gray and Sullivant are: Grandfather and Negro Mountains, N. Carol.; Tygart's Valley, Va.; and "common in moist, shady ravines in western Virginia." The specimens which came under my observation grow on *Urtica*, *Rubus*, *Aster*, *Solidago*, *Rudbeckia*, and some other plants.

After repeated and careful investigation, and with some hesitation, I have admitted this mountain plant as a distinct species, different from *C. vulgivaga*. The large pointed capsule would seem to characterize it at once; but *C. vulgivaga* offers so many different forms and sizes of the capsule, that other characters were necessary; and they are found in the tissue of the corolla, which is ever destitute of the large pellucid dots constantly observed in *C. vulgivaga*, but is composed, especially about the tube, of regular, somewhat elongated, hexangular cells, easily distinguishable in dried specimens with a common glass. In the common species the cells are linear, mostly much elongated, interspersed with the large air-cells which have been frequently mentioned. The flowers are mostly twice as large as in *C. vulgivaga*, but of the same shape and proportion, about 2 and sometimes (especially in Tygart's Valley specimens) 3 lines long; but the elongated ovary, whose stylopodium is nearly as long though only half as thick as the ovary proper, distinguishes it at once even from those forms of *C. vulgivaga* where the stylopodium is unusually large. The filiform styles are at first about the length of the stamina, but soon after they are long exserted. The capsule is very large, fully 3 lines long, globose, attenuated to a bifid point; it is larger and more acute than in any other known American species. — During the same journey the following species was abundantly collected: —

C. (LEPIDANCHE) COMPACTA, *Choisy:* caule ramoso; floribus sessilibus glomeratis 5-partitis; sepalis sub-novem leviter crenulatis orbiculatis concavis adpressis, interioribus minoribus; tubo corollæ cylindrico calycem et lacinias limbi lineari-oblongas obtusas duplo superante; staminibus limbo brevioribus; squamis pinnatifido-laciniatis; ovario cum stylopodio stylos subæquante; capsula globosa subacuta corolla marcescente obtecta 1–4-sperma. — North Carolina to Alabama, in the mountains, on shrubs, frequently on evergreens; on *Corylus rostrata*, Buncombe Co., N. Carol.; on the same, and on *Andromeda axillaris* or *spinulosa*, on the sides of Negro Mountain, N. Carol., *Prof. A. Gray* and *Mr. W. S. Sullivant;* in Alabama, on *Prinos glaber*, *Dr. Gates* (*Herb. Gray*).

This is clearly the *Cuscuta compacta* of Choisy's monograph (and of *DC. Prodr. excl. syn.*), described after speci-

From the Botanische Zeitung, Vol. IV. No. 16, April 17, 1846.

C. CUPULATA, Engelm. in litt. : caule capillaceo ; glomerulis multifloris, capitatis, sessilibus ; floribus arcte sessilibus, pentameris ; calycis campanulati, cupulati lobis transversim ovatis, apice carinatis, abrupte cuspidatis ; tubo corollæ campanulato, calyce breviore, lacinias limbi ovatas, acutiusculas, erectas, demum patentes æquante ; staminibus limbo brevioribus, filamentis filiformibus, antheris orbicularibus ; squamulis truncatis, apice fimbriatis, convergentibus ; stylis cum stigmatibus ovarium globoso-depressum duplo superantibus, apice divergentibus ; stigmatibus stylorum longitudine ; corolla circum capsulam globosam circumscissam marcescente.

Diese, der *C. Epithymum* näher als der *C. Europæa* verwandte Art, wurde von Godet am Caucasus, von Ledebour am Altai gesammelt. Choisy begreift sie mit Unrecht unter *C. major*. — A. Braun.

From Gray's Manual, ed. 1, Boston and Cambridge, 1848.

2. C. CHLOROCARPA, Engelm. : low, orange-colored ; flowers almost sessile, clustered ; *corolla* mostly 4-cleft, *open-bell-shaped, the tube about the length of the acute lobes and calyx teeth*, remaining persistent around the base of the depressed pod, the scales cut-fringed or cleft (rather small) ; stamens as long as the lobes. (*C. Polygonorum, Engelm.*) — Low grounds, covering *Polygona* and other herbs, Ohio and westward.

3. C. TENUIFLORA, Engelm. : much branched, twining high, pale-colored; flowers at length peduncled and in rather loose cymes ; *tube of the corolla cylindrical* (ventricose after flowering), *twice the length of the obtuse* [351] *spreading lobes* and of the ovate obtuse calyx-lobes, in fruit borne on the summit of the depressed pod ; scales ovate, cut-fringed ; stamens shorter than the lobes of the corolla. (*C. Cephalanthi, Engelm.*) — Swamps, common through the Western States, on *Cephalanthus* and various tall herbs.

From Gray's Manual, 5 ed., New York, 1868.

3. C. INFLEXA, Engelm. : flowers peduncled, in umbel-like cymes, 1″ long ; *tube of the mostly 4-cleft corolla* [378] *as long as the ovate acutish and minutely crenate erect inflexed lobes* and the acute keeled calyx lobes ; scales *minute and few-toothed*, appressed ; pod depressed, somewhat umbonate, of a thicker texture, brown, its top covered with the remains of the corolla. (*C. Coryli, Engelm. C. umbrosa, Beyrich*, and Ed. 2.) — Prairies and barrens, in rather dry soil, on Hazels, *Ceanothus*, and other shrubs or herbs ; from Western Virginia and Illinois southward and westward.

From Parry's Botanical Observations in Southern Utah, No. 5. (Amer. Nat., Vol. IX. 1875.)

205. Cuscuta denticulata, n. sp. : stems very slender, hair-like ; flowers few, in loose glomerules, on [348] short pedicels, small (scarcely one line long), white ; lobes of the deeply divided globular calyx almost orbicular, overlapping, concave, thinly membranaceous, denticulate, covering the short campanulate (finally urceolate) tube of the corolla ; lobes broadly oval, obtuse, spreading, at last reflexed, as long as the tube ; scales narrow, denticulate, reaching to the base of the ovate, almost sessile anthers ; styles slender, as long as the conical, pointed ovary, bearing slightly thickened (scarcely capitate) stigmas ; capsule covered by the withering corolla, indehiscent (?), enclosing one or two seeds. — St. George, Utah, on shrubs and herbs (*Coleogyne, Biscutella*) in arid soil ; the first addition to our Cuscuta-flora since my synopsis was published, 16 years ago. Apparently allied to *C. applanata*, Eng., of Arizona, but with much smaller flowers and an acute, not depressed ovary, different calyx, etc.

206. *C. Californica*, var. (?) *squamigera*, Engelm. Cusc. p. 499. On *Suæda diffusa*, Watson. Originally found in the same region by Remy and in Arizona by Dr. Palmer, always on saline herbs ; no collector has obtained the fruit as yet.

From the Botany of California, Vol. I. Cambridge, 1876.

3. C. SALINA, Engelm. n. sp. : stems slender ; flowers (1½ to 2½ lines long) pedicelled in loose cymes, [536] shorter and wider than in the next [*C. subinclusa*] ; lobes of the calyx ovate-lanceolate, acute, as long

mens collected in Alabama and Georgia ; the notice in Silliman's Journal, Vol. XLIV. p. 195, must therefore be corrected. — It is very near *Cuscuta* (*Lepidanche*) *adpressa*, which thus far has only been found on the bottom lands of the Mississippi and Illinois Rivers. This is again a remarkable instance of two nearly allied species ; one growing in the mountainous region of the Southern States, the other in the western lowlands. Analogies offer in *Baptisia alba* and *leucantha*, *Phacelia fimbriata* and *Purshii*, and others. The mountain species is distinguished from its western relative by the closer and compacter glomerules, and much more slender and mostly smaller flowers. The tube of the corolla exceeds the compact scales of the calyx considerably, and is much narrower in proportion to its length ; it gives, therefore, to the capsule which it covers a much more pointed appearance, though the capsule itself is nearly globose. This appearance of the vestiges of the corolla on the capsule distinguishes this species from *C. adpressa* just after flowering. The corolla appears to be more membranaceous than in the western species, and remains whitish when well preserved in the herbarium ; the other usually turns reddish-brown.

as the similar but mostly broader and overlapping denticulate lobes and as the shallow campanulate tube of the corolla; filaments about as long as the oval anthers; fringed scales mostly shorter than the tube, sometimes incomplete; styles as long as or shorter than the pointed ovary; capsule conical, surrounded (not covered) by the withered corolla, mostly 1-seeded. — *C. subinclusa*, var. *abbreviata*, & *C. Californica*, var. (?) *squamigera*, Engelm. l. c. [Tr. St. L. Acad. I. 499, 500].

Saline marshes, on various Chenopodiaceous plants, especially *Salicornia:* Bay of San Francisco, *C. Wright*, Bolander, Kellogg. Also extending to British Columbia (*Lyall*), and in the interior to Arizona and southern Utah. In many respects intermediate between the preceding [*C. Californica*] and the following species [*C. subinclusa*]: but distinguished from the former by the presence of infrastamineal scales and the larger flowers; from the latter by the less crowded flowers, with shorter, more delicate, and open corolla.

FROM THE BOTANICAL GAZETTE, VOL. II. 1877.

A new Cuscuta, new at least to North America, comes now from California. A great wan- [69]
derer is this *C. corymbosa*, which nearly forty years ago stirred up the botanists of Europe, and the agriculturists not less. This interesting plant has quite a little history of its own. At the period indicated, between 1839 and 1843, an unknown *Cuscuta* made its appearance almost simultaneously in different parts of western Europe, and, singularly enough, always in Lucerne fields. In Germany it was described as *C. suaveolens*, *C. Hassiaca*, *C. diaphana*, and *Engelmannia migrans*, until Choisy, in DC. Prod., recognizing its American origin, took it for *C. corymbosa*, R. & P. In my monograph of Cuscuta, 1859, I established the identity of the immigrant with the South American *C. racemosa*, Mart., which had been introduced into Europe with the much-vaunted Chilian *Alfalfa*, in reality the old established European fodder plant, the *Lucerne*, and which proved very destructive to its nurse-plant. After ten or fifteen years the energetic measures of the farmers, together with wet and cool summers, in which the seeds did not mature, seem to have eradicated the plant entirely, and as far as I am informed, it has not been heard of again in Europe. But now, lo and behold, our wanderer makes its appearance in northern California, and, precisely as before in Europe, in Alfalfa fields, "proving very injurious." It has been, without doubt, here also imported from Chili.

Rev. E. L. Greene, who has found so many new native plants in the Shasta Valley, sends also this troublesome newcomer. How long it has been there or whether it has appeared in other parts of California, where under the well-sounding name of Alfalfa the Lucerne is frequently cultivated, is as yet unknown, nor whether it will establish itself permanently. It may be well to direct the attention of the farmers, who cultivate Alfalfa, to this dangerous enemy and to urge them to destroy any dodder which may show itself in their fields, before it can spread or mature seeds. *C. racemosa*, Mart., belongs like our common *C. Gronovii* to the section *Clistogrammica*, characterized by two styles of unequal length tipped with capitate stigmas and a not-opening (baccate) capsule. Ovary and capsule are thickened towards the apex and somewhat pointed; inflorescence loosely paniculated with longish pedicels; flowers 1½–2 lines long, of thin texture, tube of corolla deeply campanulate, widening upwards, spreading lobes inflexed at the acute tip; scales nearly the length of the tube; capsule commonly enveloped by the corolla. The variety, *Chiliana*, Eng. Cusc. p. 505, to which this form belongs, has larger and more delicate flowers than the original Brazilian type.

The "new" *Cuscuta racemosa*, the Alfalfa-Dodder, was after all not new to Prof. Thurber [80]
and to the readers of the "American Agriculturist." By an unpardonable oversight his article in the number of December, 1874, of that journal, adorned with a cut, was overlooked not only in the notice published in the "Gazette" of January, but also in the Flora of California, published last summer. It seems that the parasite made its appearance in California at least three years ago on Luzerne fields, and its nature and dangerous character was recognized by Prof. Thurber and the means indicated to eradicate it. The little notice of this plant in the January number of the "Gazette" has elicited the information from California that the parasite is "now well naturalized, here (about San Francisco Bay), and is a great pest among the Chili clover."

From Watson's Contributions to American Botany, XI. (Proc. Amer. Acad. Arts and Sci., Vol. XVIII. Aug. 1883.)

C. Potosina, Schaffner mss.: stems capillary; the flowers minute (scarcely a line long), short-pedicelled [124] in small, rather loose clusters; calyx-lobes triangular, acute, scarcely equalling the deeply campanulate corolla-tube, which is rather longer than its erect, ovate, acute, somewhat inflexed and at last connivent lobes; stamens short, the subglobose anthers nearly as long as the filaments; scales broad, deeply fringed, slightly exceeding the tube; capillary styles nearly as long as the depressed ovary; capsule covered by the marcescent corolla, extremely thin, easily tearing off from its base, but not circumscissile, 1-seeded. — One of the smallest-flowered species, closely allied to *C. arvensis*, from which the very fragile, 1-seeded capsule, covered by the hood-like corolla, principally distinguishes it. — Near San Luis Potosi (779 Schaffner); growing on some labiate, probably a *Scutellaria*.

C. mitræformis, Engelm.: stems thick; flowers short-pedicelled, crowded in large glomerules; calyx-lobes orbicular, unequal, the outer carinate, fully as long as the short-campanulate corolla-tube; lobes of the corolla as long as the tube, broadly oval, rounded, at last spreading or reflexed; subulate filaments as long as the linear-oblong anthers; scales very broad, deeply fringed, exsert, incurved; ovary with very short subulate styles; capsule large, exsert, 2-horned with the broad-spreading conical styles, regularly circumscissile. — Between San Luis Potosi and Tampico, in May; Dr. E. Palmer. Flowers 3 lines and capsule 4 lines long; clusters in fruit 10 to 12 lines thick. Nearly allied to *C. Xalapensis*, but distinguished by its much larger flowers and fruit, and by its short, thick, almost conical styles.

IV.

PAPERS ON CACTEÆ.

I. CACTEÆ OF EMORY'S RECONNOISSANCE.

From a Letter in Notes of a Military Reconnoissance from Fort Leavenworth, in Missouri, to San Diego, in California. . . . By W. H. Emory. Appendix No. 2. Washington, 1848.

On the occasion of my report on the botany of Dr. Wislizenus's voyage, I have made [157] a careful investigation of the Cactaceæ, — of which he brought home with him more than twenty species, — and have been enabled to elucidate several points which had been unknown or obscure before; no doubt because in the hothouses of European gardens these curious plants, though they thrive pretty well, rarely produce flowers and fruit: so that from eight hundred species of Cactaceæ at present cultivated in Europe, perhaps not one fourth is known as to its flowers, and a much smaller proportion in fruit.

I have ventured to describe some of your species from the drawing; my description, however, and the names given by me, must remain doubtful till we are able to obtain some more data to characterize the species. I have written it more for your information than for publication; but if you choose to append it to your published report, I have no objection to it, but must request you to make such corrections or alterations as your notes or your recollection of the plants will enable you to do, — for example, as to size, as in some of the drawings no size is mentioned;* in which case I have assumed them to represent the natural size. I have, for convenience' sake, numbered the different figures, and shall now proceed to copy for you the descriptions and remarks following my numbers.

1. Mamillaria. Oct. 18, 1846. Head waters of the Gila, 6,000 feet above the sea. Proliferous in the highest degree, forming hemispherical masses often of a diameter of 3½ feet, which are composed of 100–200 different heads or stems. Single heads conical, apparently about 4 or 5 inches high and 2½–3 inches in diameter; color bluish-green; spines white or reddish.

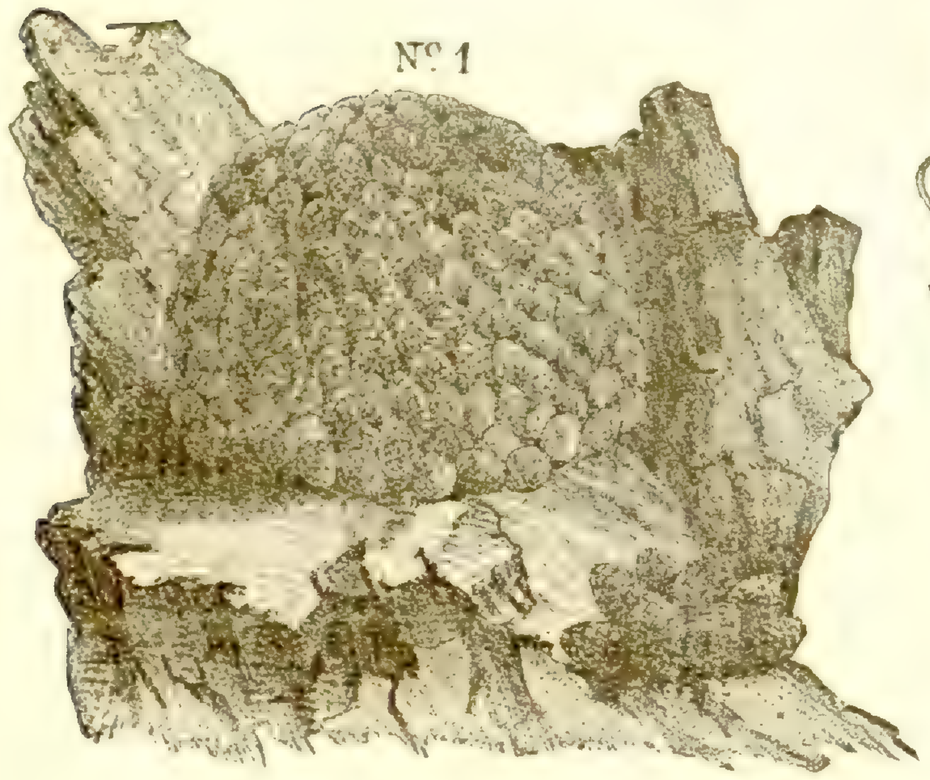
This species appears to be allied to *M. vivipara*, but is distinguished by the conical heads and the hemispherical tufts, while *M. vivipara* has hemispherical or even depressed heads, and forms flat and spreading masses. It may be an undescribed species; in which case the name of *M. aggregata* appears to be most appropriate.

2. Mamillaria. Oct. 26, 1846. Rare; on the Gila, 3,000 or 4,000 feet above the sea. Apparently a *Mamillaria*, though the habit of the plant is more that of an *Echinocereus;* but all *Echinocerei* have the bunches of spines disposed in vertical ridges, which is not the case in the figure in question. Stems irregularly cylindrical, with divers contractions and swellings, about 4–6 inches high and 1¼–1¾ inches in diameter, many (in the figure 8) from one base.

The name of *M. fasciculata* would indicate the peculiarity of this species.

* Where the size is not mentioned, the original drawings are the size of nature. — W. H. E. [The accompanying figures are reduced. — Eds.]

* Acc. to originals in MBG library and acc. to Meisel, the pagination showed the 155–158. Besides, ref. to the originals is textually considerably different!



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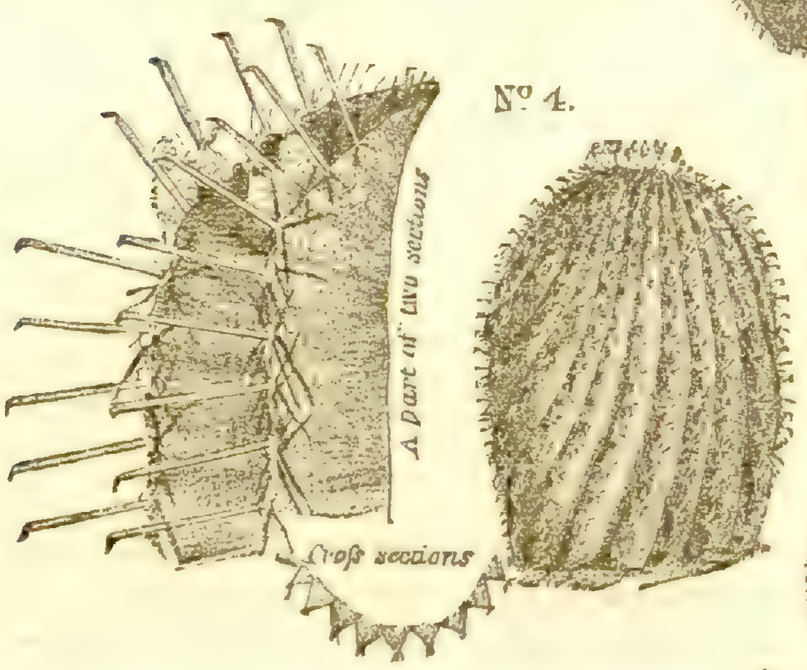

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A part of two sections

Cross sections

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3. Mamillaria. Nov. 4, 1846. Abundant. Several (fig. 3) oval stems from one base, 1½–2½ inches high and 1¼ inch in diameter; tubercles in about 13 rows; spines whitish, short; one small obovate red berry toward the apex not more than 1½ line long.

If the figure is correct, this species ought to be distinguished by the name of *M. microcarpa*, as I know of no other *Mamillaria* with such a small fruit.

4. Echinocactus Wislizeni, Engelmann in Wislizenus's Report. Oct. 26, 1846. In addition to the description in Dr. Wislizenus's Report, which I have drawn up from dried specimens, I observe in this figure that the species has twenty-one oblique ribs, is of an oval shape and bluish-green color; the ribs are acute, but not compressed, according to the representation of a section, and the grooves corresponding.

5. Echinocactus. Oct. 25, 1846. 18 inches in diameter; height equal to the diameter; shape ventricose, contracted towards the vertex, therefore somewhat urceolate; with 21 straight sharp ribs; spines apparently 8, straight, brown, color of plant bright green; vertex whitish (tomentose?); fruit 1 or 1½ inches long, oval, yellowish or reddish. Seed obovate, obliquely truncated at base, full 1 line long, black, opaque, slightly roughened; embryo curved or hooked, cotyledons accumbent, partly buried in the large farinaceous albumen.

This species is distinct from all other New Mexican species examined by me, and is most probably undescribed. I propose to name it after its zealous discoverer, — who has, surmounting numberless difficulties, though occupied by severe and arduous duties, found leisure to do so much for the advancement of our knowledge of the wild countries traversed by him, — *Echinocactus Emoryi*.

6. Cereus. Nov. 21, 1846. 3 feet high. There can be but little doubt that we have here a species before us, which I have received from Dr. Wislizenus and from Dr. Gregg, from the neighborhood of Chihuahua, [158] and which I have described in Dr. Wislizenus's report by the name of *C. Greggii*, — erect, branching, with 5 compressed ribs, dark green, with whitish areolæ, and about 8 short dusky spines.

The specimen figured here is very remarkable on account of the fruit, which was unknown to me. Provided the drawing is correct, we have here a smooth oval acuminate fruit, crowned with the remains of the corolla, and supported by a distinct stipe of a bright crimson color. A stipe, as well as such an acumination, I have not seen in any other fruit of a cactus. Fruit, with the long acumination, 2½ inches long, ¾ to 1 inch in diameter, stipe about ½ inch long.

7. Opuntia. Very abundant on the Del Norte and Gila. No date nor statement whether the figure represents the natural size or is smaller. The species belongs to the section *ellipticæ* of Salm. It is ascending, older stems prostrate, branches and younger joints erect, 8–10 inches high; joints orbicular-obovate, rounded, obtuse or sometimes acutish, of a bluish-green color, 1½–2½ inches long and little less wide; spines short and whitish; berries obovate, scarlet, only about 3 or 4 lines long. If the figure represents the natural size, this species ought to bear the name *O. microcarpa*.

8. Opuntia. Oct. 28, 1846. Common on the Gila. Much branched, sub-erect, joints obovate, often acutish, purplish, with 2 or 3 longer brown spines directed downwards; fruits obovate, red. In the figure the joints are 1½–2 inches long and 1–1¼ wide; fruit about 3 lines long.

There are several *Opuntiæ* known with purple-colored joints, but none in the least resembling this, and I must consider it as a distinct species, to which I would give the name of *O. violacea*.

9. Opuntia? Oct. 22, 1846. Abundant on the Del Norte and Gila. A remarkable plant, apparently more like a *Mamillaria* than like an *Opuntia*. The fruit is also represented without areolæ or tubercles, exactly like the smooth fruit of a *Mamillaria*; but this may be an oversight in the artist. The habit of the plant suggests the belief that it is an *Opuntia* of the section *cylindraceæ*.

Joints or branches ascending, cylindrical, tuberculated, 4–6 inches long, 1–1¼ inches in diameter; tubercles very prominent, with about 8 long (1–1½ inches) straight spines; fruit obovate, umbilicate, scarlet, towards the top of the branches, about 9 lines long and 6 in diameter. It is a distinct species, which I am gratified to dedicate to the skilful artist who has drawn all these figures, — Mr. J. M. Stanly. I therefore propose for it the name *Opuntia Stanlyi*.

10. Opuntia. Nov. 3, 1846. 4 feet high. Stem erect, with verticillate horizontal, or somewhat pendulous branches; branches cylindrical, strongly tuberculated, about 8 lines in diameter, with short spines on the tubercles; fruit pale-yellow, clavate, tuberculate, umbilicate, 1–2½ inches long, 6–8 lines in diameter.

This is probably the *Opuntia arborescens*, Engelmann in Wislizenus's Report, though the spines are represented as being shorter than in my specimens of *O. arborescens* from New Mexico and Chihuahua.

11. Opuntia. Nov. 2, 1846. Somewhat resembling the last, but forming "low, wide-spreading bushes." Joints more slender, only about 4 or 5 lines in diameter, alternating (not opposite nor verticillate), forming with the

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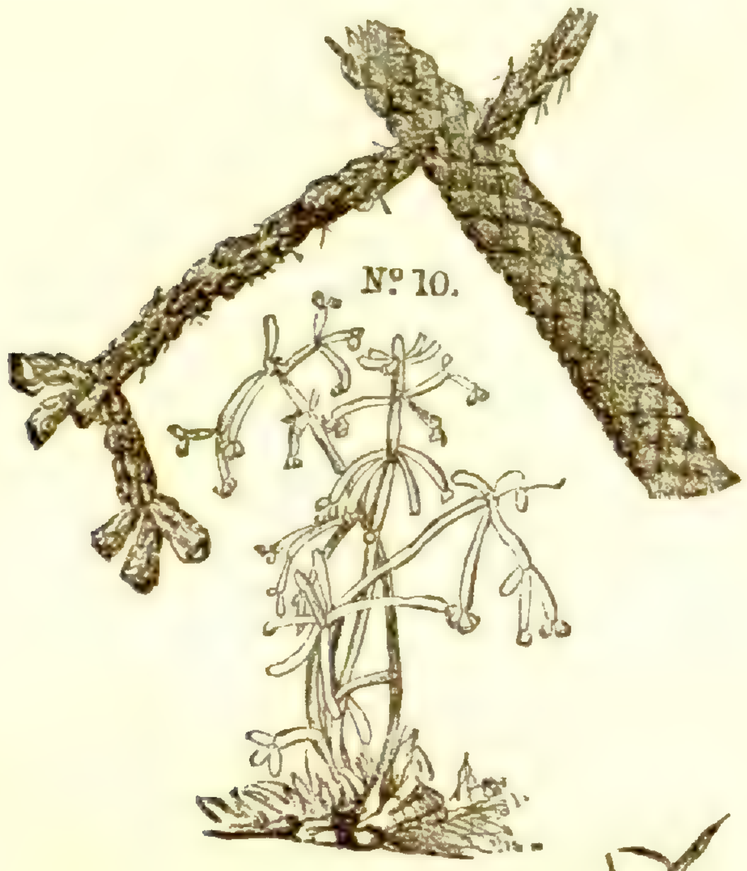

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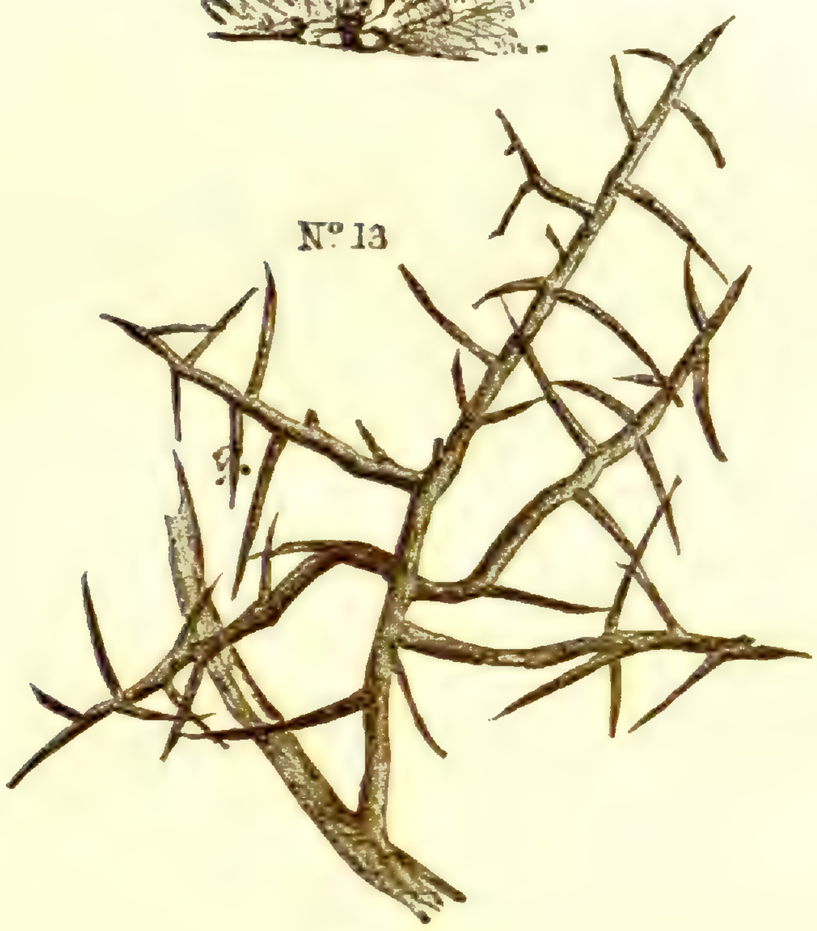

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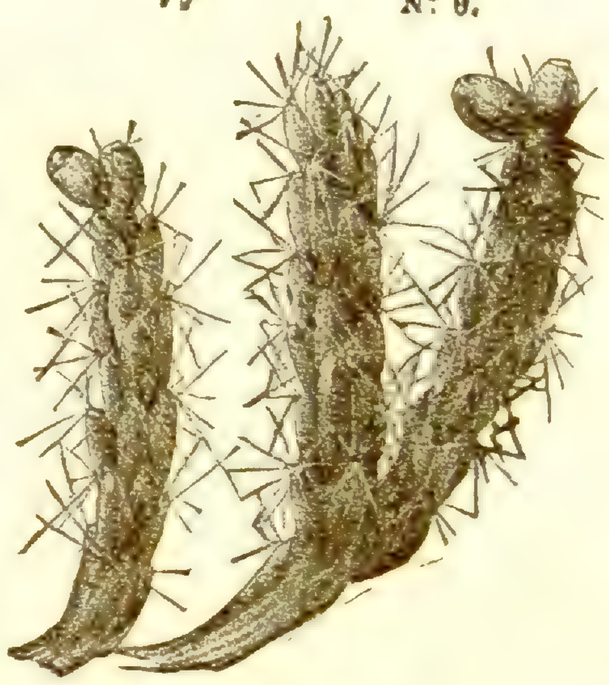

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stem an acute angle, sub-erect, tubercles more prominent, areolæ whitish at their lower edge, with 3 dusky deflexed spines; fruit clavate, tuberculate, pale yellow, 1 inch long, 4 lines in diameter.

I believe this to be an undescribed species, and would propose the name for it of *O. Californica*.

12. OPUNTIA. Oct. 10, 1846. Abundant; 3 feet high, with spreading branches; the same in circumference.

I can see no difference between this figure and a plant which I have received from El Paso by Dr. Wislizenus, and which I have described in his report under the name of *O. vaginata*.

Nos. 13–15 are no Cacti. In 13 I recognize the *Kœberlinia*, Zuccarini, — a shrub common in the chaparrals of northern Mexico, which has been collected in flower about Parras and Saltillo by Dr. Wislizenus and Dr. Gregg. The fruit is unknown so far. The specimen figured is, however, in fruit; the berry (?) is globose, ¾–1 line in diameter, crowned with the rudiment of the style. It was collected Oct. 23, 1846, and is described as a shrub 3 feet high, with low, spreading boughs.

14. Collected Nov. 15, 1846. 4 feet high; rare. Is perhaps another species of the same genus, but the entire absence of flower or fruit makes it impossible to decide. Branches similar, straight, leafless, ending in robust dark spines, but much elongated and sub-erect, not horizontal, as in No. 13.

15. Is entirely unknown to me. Perhaps it is an *Amaryllidaceous* plant. The fruit is said to be 5 inches long.

A gigantic cactus was observed along the Gila River, about the middle part of its course, at an elevation [159] of from 2,000 to 4,000 feet. It is frequently mentioned in the report from the 1st to the 9th of November, and figured on several plates (pp. 72–79). It most probably is a true *Cereus*. I judge so from the seed, which fortunately has been preserved. This is obovate, obliquely truncate at base, black, smooth, shining, small (only about 0.7 line long); the embryo is hooked, the cotyledons foliaceous, incumbent; no albumen. If it is a constant fact that the cotyledons of the seeds of the genus *Pilocereus* are thick and globose and straight, the plant in question cannot belong to that genus, which comprises the most gigantic of the Cactus tribe.

The large *Cereus*, *C. Peruvianus*, is vastly different from our plant, which I would propose to name *Cereus giganteus*. Unfortunately, I can say but little about the character of this species. The stem is tall, 25 to 60 feet high and 2 to 6 feet in circumference, erect, simple, or with a few erect branches; ribs about 20, oblique or spiral (?); no spines (?) (Emory's notes, — probably only below without spines); fruit produced toward the top of the stem or branches. (None of the fruit was procured, being too late in the season, but the molasses expressed from it by the Indians was procured in abundance at the Pimos village.) It is called *Pitahaya* by the Californians; but this appears to be a general name applied in Mexico and South America to all the large columnar Cacti which bear an edible fruit, — especially to *Cereus variabilis*, which is common on the eastern coast, but is widely distinct from our California giant.

ST. LOUIS, Feb. 13, 1848.

II. CACTEÆ OF PLANTÆ FENDLERIANÆ.

FROM MEMOIRS AMERICAN ACADEMY, VOL. IV. 1849.

244. MAMILLARIA VIVIPARA, Nutt. sub Cacto. Common from Bent's Fort to Santa Fé, on rocky hills [49] and elevated plains; flowering in July. — "Heads mostly single, often in pairs, rarely cæspitose from the ramifications of the subterraneous stem;" not proliferous, as some specimens from the Upper Missouri are. — There can be little doubt that this is the true *Cactus viviparus* of Nuttall, although the flowers do not appear to be entirely central. I have living specimens from Santa Fé and from the Upper Missouri, and shall be able to decide their identity after having seen them flowering. — I possess also a living specimen of Nuttall's *Cactus mamillaris* (Gen. p. 295), and have observed its flower and fruit. It is, as has been long suspected, entirely different from the West Indian *Mamillaria simplex*, DC., and is nearly related to *M. similis*, Engelm. in Pl. Lindh. I have named it after its discoverer.[1]

[1] M. NUTTALLII, sp. nov.: simplex (an semper?), globosa, axillis tuberculorum ovato-cylindricorum supra leviter sulcatorum subtomentosis; areolis junioribus albo-tomentosis; aculeis rectis albidis, radialibus 13–16 subinæqualibus setaceis, centrali porrecto robustiore; floribus ex axillis tuberculorum hornotinorum centralibus (ex rubello flavicantibus); sepalis petalisque oblongo-lanceolatis; sepalis 10–13, brevioribus exterioribus ciliato-fimbriatis obtusiusculis, interioribus apice laceris acutis; petalis 20–23 integris breviter abrupte mucronatis; stylo supra stamina (rubella) paulo exserto, stigmatibus circa 5 brevissimis erectis adpressis viridibus; baccis lateralibus subglobosis coccineis. *Cactus mammillaris*, Nutt., non Linn. — On high, dry prairies, about Fort Pierre, on the Upper Missouri; flowering in May. — My specimen is 1½ inch high, and of the same diameter; the tubercles 6 or 7 lines long, in 8 spiral rows, slightly sulcate. Radial spines 4 or 5;

245. M. PAPYRACANTHA, sp. nov.: ovata, prolifera, aculeis omnibus planis chartaceis flexilibus albis, radialibus brevibus 8 centralibus 3–4 multo longioribus, 2–3 superioribus sursum curvatis, singulo inferiore longiore latiore deorsum flexo; floribus centralibus (albidis); sepalis 12–16 ovatis acutis integris; petalis sub-13 lanceolatis acuminatis integris; stigmatibus 5 suberectis exsertis albidis. — In a valley between the lower hills, near Santa Fé, in loose, red sandy, though fertile soil: found only once; flowering in May. — About 2 inches high and 1½ inch in diameter; the tubercles in about 8 spiral rows; lower ones proliferous; their shape not well distinguishable in the half-rotten specimen before me. Spines silky-white, shining, of the consistency of stiff paper. None of the 8 radiating spines (1½ or 2 lines long) are directed upwards, but all laterally or downwards; the 2 or 3 central curved [50] spines are directed upwards, and 6 to 8 or 9 lines long, the middle ones shorter or wanting. The lower central spine is the longest (10 to 14 lines) and broadest, being from 1 to 1¼ line wide. Flowers pearly white, 12 to 13 lines long and 12 to 15 lines in diameter. Lower sepals membranaceous; the upper herbaceous in the middle. Petals about two lines wide.

246. CEREUS VIRIDIFLORUS, Engelmann in Wislizenus's Report, note 8, sub Echinocereo. Eastern mountains of Santa Fé, on sunny, rocky declivities; flowering in May and June. — I have seen specimens brought from other parts of New Mexico of much larger size than those of Fendler or Wislizenus; some of them 1½ inch in diameter and 3 to 4 inches high, some with stout central spines, others entirely destitute of them.[1]

247. C. COCCINEUS, Engelm. l. c., sub Echinocereo. Higher mountains about Santa Fé; often in large [51] clusters of 8 or 15 heads; flowering in May. — The areolæ are hardly oval, but almost orbicular, and are distinguished from those of most related species by their large size. — Among a number of plants of this family which Mr. Fendler sent from Santa Fé in a living state, but which unfortunately were all dead when they came to hand, are some specimens which appear to be varieties of this species, namely: — β. MELANACANTHUS: aculeis radialibus 10–12 cinereis, centrali longissimo atrofusco porrecto recto seu leviter deorsum curvato. — γ. CYLINDRICUS: subsimplex cylindricus; aculeis 8 radialibus, singulo robustiori porrecto.

248. C. TRIGLOCHIDIATUS, Engelm. l. c., sub Echinocereo. Higher mountains about Santa Fé; also in gravelly soil on the lower hills; flowering in May and June. — To the description given in Wislizenus's Report I will add here that the spines are often somewhat curved; the ridges are sharp, but the grooves between them very wide and shallow; the areolæ widely distant from one another (often over 1¼ inch); and the expression "*areolis sparsis*," in the character, ought to be changed to *areolis distantibus*.

the central one 5 to 6 lines long; the young spines at the apex slightly brownish. Flowers an inch long, and, when fully expanded, of the same diameter; petals about 2 lines wide, acute, abruptly mucronate; stigmas only from ½ to ¾ of a line long, erect. The fruit ripens the following spring, and, as well as the seed, is very similar to that of *M. similis*, but only half as large, although the pits of the globose black seed are of the same size.

[1] After a careful revision of the characters which distinguish my genus *Echinocereus* (Wisl. Rep. note 7) from *Cereus* proper, I think it most natural to unite the two. Echinocereus will then constitute the first section of Cereus, and comprise those of low stature and mostly of cæspitose growth, having diurnal flowers with short tubes (and almost straight embryos, with very small cotyledons). It appears to comprise Prince Salm Dyck's (ined.) first two sections, namely: 1. *Lophogoni*, and 2. *Sulcati*; but perhaps not all of the latter. Those known to me as belonging to New Mexico, Chihuahua, and Texas, may be divided into two sections, namely: —

§ 1. COSTATI: caule 4–10-costato; aculeis radialibus pl. m. porrectis non pectinatis; areolis orbiculatis.

A. *Tuberculis subdistinctis.*

1. C. PROCUMBENS, sp. nov. ined.: tuberculis 4–5-serialibus; aculeis brevibus tenuibus, 5–6 radialibus, 1 centrali. — Matamoras.

B. *Tuberculis in costas confluentibus.*

* *Aculeis plus minusve teretibus.*

2. C. COCCINEUS, Engelm. in Wisl. Rep. not. 9. Costis 9–11; aculeis radialibus 9–10, centrali 1 recto.

3. C. POLYACANTHUS, Engelm. l. c. not. 28. Costis 10; aculeis radialibus 10–12, centr. 4 rectis.

4. C. RŒMERI, sp. nov. ined.: costis 7–9; aculeis radialibus 8, centrali 1 recto. — Western Texas.

5. C. FENDLERI, sp. nov. supra: costis 9–10, aculeis radialibus 7, centrali 1 curvato.

* * *Aculeis compressis, angulatis.*

6. C. ENNEACANTHUS, Engelm. l. c. not. 46. Costis 10; aculeis radialibus 8, centrali 1 recto.

7. C. TRIGLOCHIDIATUS, Engelm. l. c. not. 9. Costis 6–7; aculeis 3–6 subcurvatis.

§ 2. SULCATI: caule sinubus 10–24 parum incisis sulcato; areolis pl. m. elongatis; acul. rad. pectinato-connatis.

8. C. DASYACANTHUS, Engelm. l. c. not. 19. Septdec.–octodecim-sulcatus; aculeis radialibus subporrectis, centralibus radiales subæquantibus, pluribus deflexis.

9. C. RUFISPINUS, Engelm. l. c. not. 31. Undecim-sulcatus; aculeis rad. adpressis variegatis elongatis, centrali 1 robusto.

10. C. ADUSTUS, Engelm. l. c. not. 29. Tredecim–15-sulcatus; aculeis rad. pectinatis albidis adustis, centrali nullo seu 1 robusto. The last form is β. RADIANS (*Echinocereus radians*, Engelm. l. c. not. 30).

11. C. VIRIDIFLORUS, Engelm. l. c. not. 8. Tredecim-sulcatus; aculeis rad. pectinatis variegatis, centrali nullo seu 1 robusto.

12. C. PECTINATUS, Scheidw. sub Echinocacto; Engelm. l. c. not. 45, sub Echinocereo. Octodecim–23-sulcatus; aculeis radialibus pectinatis, centralibus 2–5 brevissimis.

13. C. CÆSPITOSUS, Engelm. in Pl. Lindh. Tredecim–18-sulcatus; aculeis rad. pectinatis, centrali nullo.

249. C. FENDLERI, sp. nov.: globoso-ovatus, simplex vel e basi proliferus, cæspitosus; costis 9–10 obliquis tuberculatis interruptis; areolis orbiculatis approximatis; aculeis basi bulbosis robustis, radialibus sub-7 compressis subincurvis fuscis demum cinereis (tribus inferioribus longioribus, superioribus brevioribus, summo nullo); aculeo centrali robustiore longiore teretiusculo sursum curvato atro-fusco; floribus campanulatis; tubo pulvillis sub-30 albo-tomentosis stipato, inferioribus aculeos setaceos albos apice adustos 8–12 radiales et singulum centralem, superioribus aculeos sub-3 robustiores longiores curvatos albos gerentibus; sepalis interioribus 12–15 lineari-lanceolatis acutis; petalis oblongo-linearibus, acutis vel obtusis 16–24; stigmatibus 12–14 viridibus stamina numerosissima vix superantibus. — β. PAUPERCULUS: aculeis robustis abbreviatis, radialibus 5–7, centrali subnullo. — Santa Fé, on elevated sandy plains; flowering in June. — The specimens before me are 2½ inches high, and at the base of the same diameter; the areolæ from 4 to 6 lines distant; the lower radial spines 7 to 10, the upper from 3 or 4 to 6 lines long; central spine somewhat erect, curved upwards, 10 to 15 lines long. In var β. the spines are all from 3 to 6 lines long. The upper spine is wanting in all my specimens, and the opposite lowest one is longer than any except the central spine. Flowers from 2½ to 3¼ inches long and wide, violet-purple. The spines on the lower part of the tube are from 2½ to 3, and on the upper from 3 to 5 lines long. Petals variable in shape.

250. OPUNTIA PHÆACANTHA, sp. nov.: diffusa; articulis obovatis seu orbiculato-obovatis compressis; [52] areolis orbiculatis fusco-setosis margine inferiore aculeos robustos 1–5 rectos compressos inæquales fuscos apice pallidiores plerumque deflexos gerentibus rariusve nudis; ovario obconico areolis sub-30 tomento pallide fusco instructis, superioribus albo-setosis; sepalis interioribus sub-20 late obovatis retusis seu emarginatis; petalis 10–13 obovatis retusis seu emarginatis; stigmatibus 5-7 suberectis stamina vix superantibus; bacca obovato-pyriformi nuda. — On rocky hills about Santa Fé, and on the Rio Grande, very common; flowering in May and June. This appears to be the most northern form of the Opuntiæ with yellow or brown and flattened spines, which belong to the section of *O. Tuna*. Another species, with larger joints and larger fruit, occurs in Texas. — Some specimens before me are prostrate, with ascending branches; the joints 5 or 5½ inches long and 3½ or 4 wide; areolæ an inch distant from each other, most of them bearing stout spines; the lower sometimes only 1, the upper from 2 to 5, but mostly 3 or 4; one or two are directed upwards, the other and stouter ones more or less downward. Larger spines 1½ to 2 inches long, dark brown with lighter tips; the smaller from ½ inch to 1 inch long, whitish. — Another specimen has larger, more orbiculate joints, from 6 to 8 inches long and 5 or 6 wide; the spines fewer, all directed downwards, or on many areolæ none at all. The flowers which have been distributed under this number are 2 or 2½ inches in diameter; ovary about 1 inch long; sepals yellow with red; petals yellow; stamens red or yellow; stigmas apparently green. The fruit which Mr. Fendler says belongs to this species is about half an inch long, red, smooth, apparently juicy when fresh; the seeds often 3 lines in diameter, margined like those of *O. vulgaris*. — Several other Opuntiæ with compressed joints, some of them with fleshy, others with dry and spiny fruit — some of them very spiny, and others almost destitute of spines, — have been collected by Mr. Fendler about Santa Fé; but for want of more complete materials, a description is not here attempted.

251. O. CLAVATA, Engelmann in Wislizenus's Report, note 12. Plains around Santa Fé, — never found on the mountains; flowering in June. — I add to the description already published, that the areolæ are very large and closely approximate. From 9 to 11 smaller and narrower spines are directed upwards or radiating; about 6 of them are turned downward, and are larger and longer; the former are from 2 to 4, or even 6 or 8, lines long; the latter are from 6 to 14 lines long. The joints form a large and spreading, level-topped mass, which attains the diameter of several feet.

252. O. ARBORESCENS, Engelm. l. c., note 5. Hills and elevated plains, from Bent's Fort, on the Arkansas, to Santa Fé; flowering in June. — About 5 feet high, sometimes as much as 5 inches in diameter [53] below; the older stems and branches terete; the younger joints strongly tuberculated. Spines often an inch long; generally from 15 to 25 in each fascicle.

III. CACTEÆ OF ENGELMANN AND GRAY'S PLANTÆ LINDHEIMERIANÆ.

Part I. From Boston Journal of Natural History, Vol. V. 1845.

244. Opuntia fragilis, Nutt., var. frutescens. O. frutescens, Engelm. mss. Near the Muskit- [245 (37)]
thickets (*vide* No. 233), on the Colorado; often acquiring the height of 4 or 5 feet, with a branching ligneous stem, covered with light gray bark, and sometimes with lichens. It bears bunches of small capillary spines, with one larger one (4–5 lines long); these disappear from the older stems. The wood is hard and close-grained. The younger branches are green and terete (or angular when withered), and bear the ultimate articulations, which are about an inch long, and very easily break off. These bear when young, like other Opuntiæ, short terete subulate leaves, with a single spine in their axils, and above this a bunch of small ones. The specimens are not in flower, but are covered with the obovate umbilicate scarlet fruits, which are about 8 lines long, fleshy, but not juicy, and contain very few (2–5) white, compressed seeds. What is most remarkable, these fruits are often proliferous, and bear from 1 to 4 or 5 new branches from the upper bunches of spines. The fruit either falls off with these branches, or else dries up, persists, and finally forms part of the stem.[1]

[1] Mr. Lindheimer has sent seven other Cacti, mostly in living specimens, namely: — [246 (38)]

1. Opuntia, sp.: without fruit or flower; probably *O. vulgaris*. It attains the height of several feet, with large obovate joints and a few spines.

2. O. Missouriensis? Perhaps *O. vulgaris*, but very spiny.

3. Mamillaria similis, n. sp.: cæspitosa; axillis tuberculorum juniorum paulo tomentosis demum glabris; tuberculis ovatis supra leviter sulcatis (sulco basin versus subtomentoso) apice spiniferis; spinis (circ. 12) æqualibus rectis radiantibus albidis, junioribus puberulis basique tomento circumdatis; baccis sparsis globosis coccineis. — Sandstone rocks, near Industry. Evidently near *M. simplex*, — at least to Nuttall's plant of that name, — but cæspitose, forming tufts often a foot in diameter. Flowers not seen. Berries scarlet, of the size of a large pea. Seeds numerous, subglobose, scrobiculate, black, with an elongated white hilum. I have living plants, but they have not yet flowered.

4. M. sulcata, n. sp.: cæspitosa; tuberculis ovato-oblongis sulco subinde apicem versus prolifero superne exaratis apice spiniferis; spinis rectis radiantibus cinereis e tomento albido deciduo (in plantis adultis spina centralis subrecurva majore) ortis; floribus centralibus fasciculatis e tomento ortis glaberrimis, tubo brevi; sepalis lanceolatis acuminatis viridi-flavescentibus margine integerrimis; petalis longioribus lanceolatis apicem versus ciliato erosis cuspidatis sordide flavis ad basin intus filamentisque brevibus rubicundis; stylo supra stamina exserto; stigmatibus 7–10 flavis; baccis oblongis virescentibus. —With the preceding. Flowers opening for two or three days, in direct sunshine, 2 inches or more in diameter. On account of the central flowers, this should form, with *M. vivipara*, a distinct section. From that species it abundantly differs, not only in the color of the flower and the spines, but in the entire and smooth sepals, denticulate petals, etc. [This pretty species has also flowered in the Cambridge Botanic Garden.]

5. Echinocactus setispinus, n. sp.: subglobosus, apice retusus; costis plerumque 13 acutis subobliquis; aculeis 15–18 fasciculatis tenuibus flexuosis flavicanti-fuscis, superioribus 3–5 elongatis, 1–3 centralibus longissimis erectis, cæteris radiantibus; floribus minutis solitariis e macula subtomentosa supra fasciculos aculeorum ortis; sepalis in tubum concretis, apicibus liberis late ovatis acuminatis scariosis margine fimbriatis; fructibus . . .; seminibus ovatis nigris opacis minutim tuberculatis. — Muskit-thickets, on the Colorado River. Near *E. tenuispinus*, Link & Otto, from Brazil. Our specimens are about 2 inches in diameter and 1½ inch high, with pretty sharp ribs separated by deep grooves. The longest spines are 15 lines long; flowers about 5 lines long.

6. E. Lindheimeri, n. sp.: hemispherico-depressus, vertice tomentoso; costis 21 verticalibus acutis subundulatis; spinis e cicatrice ovato-lanceolata tomentosa ortis fasciculatis compressis cinereo-rubellis transversim annulato-striatis, exterioribus 6–7 inæqualibus radiantibus subrectis centrali recurvata multo brevioribus; floribus e vertice depresso tomentoso ex axillis fasciculorum spinarum hornotinorum provenientibus confertissimis; sepalis (80–100) in tubum brevem infundibuliformem lanosum coalitis lanceolatis spinoso-aristatis, interioribus margine fimbriatis; [247 (39)] petalis (40–50) lineari-oblongis margine fimbriato-laceris apice bifidis aristatis; staminibus numerosissimis æqualibus inclusis e toto tubo ortis stylo compresso brevioribus; stigmate irregulariter 14–17-fido. — On deserted ant-hills, near the Colorado River. Often a foot in diameter: our specimens are 8 or 9 inches in diameter and 4 or 5 inches high. Spines strongly annulate, stout, the larger ones often 2 inches long. Flowers about 2 inches in length, twelve or more aggregated in the woolly centre. The petals at the base are scarlet, verging to orange, from which a pale purple or violet midrib extends to the apex, and is prolonged into a delicate bristle of the same color, while the upper part of the petal is pearly white, with feathery margins. The flowers remain for three days, expanding only in bright sunshine.

7. Cereus cæspitosus, n. sp.: ovato-globosus demum cylindricus, apice depresso-umbilicatus; costis sub-15 e tuberculis confluentibus ortis rectis; aculeis numerosis ex areola oblonga albo-tomentosa demum glabrata radiatis nunc recurvis, lateralibus longioribus; floribus ex axillis tuberculorum anni prioris lateralibus; ovario oblongo tuberculis e lana villosa spinigeris stipato; sepalis 40–50 apice spinis setiformibus villoque coronatis virescentibus, intimis lanceolatis acuminato-aristatis glabris coloratis; petalis 30–40 apicem versus ciliato-denticulatis, exterioribus subito acuminatis, interioribus obtusis cuspidatis; staminibus inclusis stylo brevioribus; stigmate viridi infundibuliformi 13-partito. — Gravelly soil, near Cat-Spring, west of San Felipe. A singular reduced Cereus, quite cæspitose, and even proliferous occasionally, in the manner of Opuntia, beginning to flower when only 2 inches high, and scarcely taller than broad, but attaining the height of at least 6 inches; the ribs from 12 to 17. It is in flower for two days; the flowers about 2 inches broad when fully expanded. Petals rose-purple. Filaments reddish at the base, yellow at the summit.

Part II. From Boston Journal of Natural History, Vol. VI. 1850.

Mr. Lindheimer has again sent many living specimens of Cactaceæ from New Braunfels, San Antonio, the Pierdenales, and the Liano. Among them I not only recognized all the species described in Plant. Lindh. (Boston Journal, Vol. V.), but found also a number of new forms. From other sources I have obtained other species from the lower Rio Grande. All these will be enumerated here in order to complete, as far as possible, the catalogue of the Texan Cactaceæ. A correspondence with Prince Salm Dyck, — than whom none is better acquainted with these curious plants, — and his examination of living specimens of most of the species, enables me to give this revision an authenticity not otherwise attainable.

MAMILLARIA.

§ 1. Fructu viridi, ovali; corolla persistente; testa seminum pergamentacea fusca; floribus ex axillis tuberculorum hornotinorum.

M. calcarata. *M. sulcata*, Engelm. Pl. Lindh. l. c., non Pfeiffer. Near *M. scolymoides*, Schdw., but sufficiently distinct, according to Prince Salm. — Rocky and hard, clayey soil, on the Upper Guadaloupe. My [196] specimens from there are mostly densely cæspitose; tubercles in thirteen oblique rows; proliferous groove producing the buds always near its upper end. Flowers 2 inches long and 2 to 2½ inches in diameter; sepals (or rather outer firmer perigonial leaves) 20–35; petals (inner more delicate petaloid perigonial leaves) 30–35; yellow (dirty yellow only when fading), reddish at the base.

M. compacta, Engelm. in Wisliz. Rep. note 32, from the mountains of Chihuahua, is mentioned here only in order to add to the description of the plant that of the flower, which I have had occasion to examine in the living state. — Floribus in vertice dense lanato centralibus; sepalis (17–19) lanceolatis acutis integris (rufescentibus, interioribus margine flavis); petalis (28) oblongo-lanceolatis mucronatis versus apicem denticulatis (sulphureis); stigmatibus 7–8 cuspidatis flavicantibus supra stamina (sulphurea) paulo exsertis. — Flowers at the end of June and beginning of July (in St. Louis). Flower-bud dark reddish-brown; flower about 15 lines long and of the same diameter. Petals 6 lines long and 1¾ lines wide. Stigmata 2 lines long, cuspidate, as in *M. vivipara*, while all other species known to me have obtuse stigmata.

M. radiosa, n. sp.: simplex s. parce prolifera, ovata seu cylindrica; tuberculis teretibus supra plus minus sulcatis apice ex tomento albo aculeatis; aculeis rectis numerosis valde inæqualibus, plurimis (20–30) radiantibus tenuioribus albidis, centralibus 4–5 robustioribus fuscis s. rarius flavis, 3–4 sursum directis, singulo deflexo; axillis nudis, sulco subtomentoso; floribus (violaceis) ex axillis tuberculorum hornotinorum ortis sparsis (nec centralibus); sepalis petalisque lineari-lanceolatis acuminatis aristatis; sepalis (40–50) arachnoideo-fimbriatis, exterioribus brevioribus adpressis, interioribus longioribus recurvatis; petalis (30–40) integris s. basi subciliatis patentibus; staminibus (violaceis) numerosissimis æqualibus; stylo longe exserto; stigmatibus 7–9 (violaceis) erectis obtusis; bacca oblonga viridi floris rudimento coronata; seminibus fulvis ovatis scrobiculato-punctatis. — Sterile, sandy soil on [197] the Pierdenales; flowers (in St. Louis) about the middle of June. The flowers open for three days, in direct sunshine only, and later than most other Cactaceæ, — namely, from twelve or one till three or four o'clock. Stems 2–4 inches high, about 2 inches in diameter, dark green; tubercles in 13 oblique rows;[2] radiant spines 3–4; central spines from 4–6 lines long; flowers 1½–?¼ inches long, and about the same diameter when fully open, of a lighter violet color or of a splendid dark purple; stigmas deep velvety purple. — Very near *M. vivipara*, Haw., which has been found from the Upper Missouri to Santa Fé. This, however, is distinguished by its low, mostly cæspitose growth, by the smaller number of radiant spines (14–18), the absence of the deflexed central spine, the smaller *central* flowers, the apiculate stigmata and smaller seeds; it also flowers earlier (in St. Louis about the middle of May), but, like *M. radiosa*, opens the flowers only after twelve o'clock. In *M. vivipara* the youngest tubercles produce in their axils the flowers which appear central, and remain so till after fructification, whereupon new tubercles are developed in the centre, and the young fruit is pushed aside and becomes more and more lateral. In *M. radiosa* the flower-buds are also formed in the axils of the first young tubercles of the season, but are immediately pushed aside by a continuous growth of more tubercles; the buds, as well as the flowers and fruits, are therefore lateral. *M. vivipara* has not yet been found in Texas, though it may be expected in the mountainous regions bordering New Mexico.

[2] It will hardly be necessary to mention that there are several different sets of rows of tubercles observable; but one set is usually more distinct than the others. They depend on the size of the plant, and the number, size, and closeness of the tubercles. It is well known that in different specimens of the same species they turn to either side, right or left.

§ 2. FRUCTU COCCINEO; COROLLA DECIDUA.

* *Fructu clavato elongato; seminum testa pergamentacea, fusca; caule simplici, succo lacteo; floribus ex* [198] *axillis tuberculorum anni prioris.*[3]

M. APPLANATA, n. sp.: simplex, depressa; tuberculis elongato-pyramidatis subquadrangulatis apice ex tomento albo lanoso demum evanescente aculeiferis; aculeis rectis 15–20 tenuioribus inæqualibus radiantibus, singulo centrali robustiori erecto; axillis nudis; floribus sordide albidis s. rubellis; ovario glabro, sepalis 8–13 lanceolatis; petalis 12–18 lanceolatis mucronatis, internis versus apicem fimbriato-denticulatis; stigmatibus 5–8 stamina brevia pauca flavida longe excedentibus flavis; baccis elongato-clavatis; seminibus subgloboso-ovatis scrobiculatis rugulosis parvis. — Rocky plains on the Pierdenales; flowers (in St. Louis) in May. Flowers forming a circle or wreath, in the larger specimens, of 1–1½ inches diameter, around the growth of tubercles of the same year, while the scarlet fruit is frequently still persistent, and forms an outer circle. Plant 2½ to 4½ inches in diameter, 1–2 inches high, with an almost level top and depressed vertex; in larger specimens 34, in smaller ones 13 or 21, spiral rows of tubercles are most conspicuous. Radiating spines 2½–6 lines long, whitish; the 3 or 4 outer or lower are stouter and very light brown; the central spines erect, or rather somewhat inclined upwards and inwards, 2–4 (mostly 3) lines long, light yellowish-brown. The innermost tubercles of the preceding year appear to produce the inconspicuous flowers, which are from 9 to 12 lines long, urceolate when not fully expanded in bright sunshine. Berry 8 to 15 lines long.

M. HEMISPHÆRICA, n. sp.: simplex, hemisphærica; tuberculis elongato-pyramidatis subquadrangu- [199] latis apice ex tomento albo brevi mox evanido aculeiferis; aculeis rectis, 9–10 tenuioribus inæqualibus radiantibus, singulo centrali robustiori porrecto; axillis nudis; floribus sordide albidis s. rubellis; ovario glabro; sepalis sub-13 lanceolatis acutis vel obtusiusculis; petalis sub-13 oblongo-lanceolatis mucronatis integris s. versus apicem denticulatis; stigmatibus 5–8 ex flavido rubellis supra stamina numerosa rubella exsertis; baccis elongato-clavatis; seminibus elongato-ovatis rugulosis minutis. — Below Matamoras, on the Rio Grande; brought home by the St. Louis Volunteers in 1846; flowers (in St. Louis) in May. Very similar to the last species, but well distinguished by the hemispherical shape, the much smaller number of shorter spines, the less woolly areolæ, and the much smaller, less rough, and lighter-colored seed. I can see no essential difference in the flower. Body of the plant 3–4½ inches in diameter, 2–3 inches high; flowers 10–15 lines long and about the same diameter when fully open in the forenoon sun, urceolate in the afternoon. Radial spines 2 or 3–4, the central spine 2–3 lines long.

M. GUMMIFERA, Engelm. in Wisliz. Rep. note 33, has now flowered with me, and proved, as was expected, similar to the two foregoing species. I add here the description of the flower. — Floribus rubellis; ovario glabro; sepalis sub-13 oblongo-linearibus obtusiusculis fimbriatis; petalis 16 lanceolatis breviter acuminatis denticulato-erosis; stigmatibus 6 stamina brevia rubella longe excedentibus petala subæquantibus virescentibus. — Flower 15 lines long, 6–12 lines wide when fully open, brownish-red outside, the petals reddish-white, with dark red in the middle. Flower larger than that of *M. applanata*, much darker and more elegantly colored; style longer, etc. Fruit not seen.

* * *Fructu subgloboso; seminum testa dura nigra; caule prolifero (an semper?), succo aqueo; floribus ex axillis tuberculorum hornotinorum.*

M. NUTTALLII, Engelm. in Plant. Fendl., from the Upper Missouri. The only specimen I possessed [200] was unfortunately destroyed. — *Mamillaria similis*, Engelm. in Plant. Lindh. l. c., first discovered by Mr. Lindheimer near the Brazos, has since been found by him south of the Guadaloupe, about New Braunfels, and on the Pierdenales, in several forms. It has frequently flowered with me, and annually produces abundant fruit. I substitute the following character and description.

M. SIMILIS: subsimplex s. plerumque cæspitosa; tuberculis ovato-cylindraceis supra plus minus sulcatis (sulco in junioribus basin versus tomentoso sæpe prolifero) axilla tomentosis; areola albo-tomentosa demum nuda; aculeis 10–12 rectis albidis, radiantibus tenuioribus æqualibus, centrali nullo s. singulo robustiori; floribus ex axillis tuberculorum hornotinorum subcentralibus s. demum lateralibus (flavis s. ex rubello flavicantibus); sepalis petalisque linearilanceolatis acuminato-aristatis; sepalis 15–25 ciliato-fimbriatis sæpe plus minus recurvis; petalis 20–30 integris s. basi subciliatis; stigmatibus 5–8 virescentibus supra stamina numerosissima exsertis; bacca obovato-subglobosa coccinea; seminibus nigris subglobosis scrobiculatis majoribus.

[3] It has been stated over and over again that all the *Cactaceæ parallelæ* (with cotyledons parallel to the more or less compressed sides of the seed, see Wisliz. Rep. pp. 91 and 92) produce the flowers from the same year's growth, and the *Cactaceæ contrariæ* (cotyledons contrary to the compressed sides of the seeds) from that of the last preceding or former years. In Wisliz. Rep. l. c., I have stated that some Mamillariæ probably formed an exception to that rule. What was a supposition then I have since ascertained to be the fact. These few species, however, are the only ones in which I have as yet observed this exception.

α. CÆSPITOSA : gracilior ; aculeis radiantibus sub-12, centrali subnullo ; sepalis 15–20 ; stigmatibus sub-5.

β. ROBUSTIOR : subsimplex ; aculeis radiantibus sub-10, centrali robustiori ; sepalis 20–25 ; petalis 25–30 ; stigmatibus 7–8. Flowers (at St. Louis) in May. — Stems 1½–2½ inches high, obovate, of smaller diameter ; tubercles in *α.* 8, in *β.* often in 13 rows ; spines 3–4, in *β.* 4–8 lines long ; central spine, when present, 6 lines long. Grooves proliferous towards the upper or the lower end. Flowers 1½–2 inches long, and of the same diameter when fully open, radiating like stars with their pale yellow, silky lustre, giving this species a most beautiful appearance when several open on the same morning ; petals 12–15 lines long and 2 lines wide. Berries 3–5 lines in diameter.

ECHINOCACTUS. [201]

The specimens described in the account of Lindheimer's plants under the name of *E. setispinus* were the most northern and rather diminutive forms of this beautiful species ; the flowers were incorrectly described from a withered bud adhering to one of the specimens. Numerous plants have since been sent by Lindheimer from San Antonio, and by the St. Louis Volunteers from the lower Rio Grande.

E. SETISPINUS, Engelm. l. c. : ovato-subglobosus s. oblongo-cylindraceus ; costis 13 acutis sæpe undulatis s. subinterruptis plus minus obliquis ; areolis remotis, junioribus flavido- s. albido-tomentosis ; aculeis radiantibus setiformibus 10–16, summis longioribus imisque flavicanti-fuscis, lateralibus albidis, centrali subsingulo robustiori fusco flexuoso s. apice uncinato ; floribus solitariis nudis infundibuliformibus, tubo glaberrimo ; sepalis inferioribus brevioribus obtusis s. cuspidatis 25–40, superioribus elongatis lanceolatis 15–25 omnibus margine membranaceis basi auriculato-cordatis tenuiter ciliatis ; petalis 20–30 (cum basi miniata flavis) oblanceolatis acutis integris s. denticulatis ; stylo supra stamina rubella longe exserto ; stigmatibus 5–8 sulphureis recurvis s. erectis ; bacca pulposa globosa rubra rudimentis sepalorum infimorum membranaceis stipata.

α. HAMATUS : major, subovatus ; aculeis radialibus 10–12, centrali robustiori hamato. *E. hamatus*, Muhlenpf. *E. Muhlenpfordtis*, Fen.

β. SETACEUS : minor, subglobosus ; aculeis radialibus 14–16, centralibus 1–3 setiformibus flexuosis. *E. setispinus*, Engelm. l. c. — Texas, from the Colorado to the Rio Grande. Flowers from April or May to October, and therefore, on account of its beautiful flower, one of the most valuable species for cultivation. — Plant 2–4 inches in diameter and 1½–6 or 8 inches high ; flowering when quite small, simple or (in cultivation at least) sometimes proliferous at base. Var. *α.* is the larger southern form, with fewer, stouter, and longer spines (radial 6–16 lines, central 12–16 lines long). Var. *β.* is the smaller, more northern form, with more and thinner spines (radial 5–10, central [202] 12–16 lines long). Flower from 20 to 35 lines long and 24–30 in diameter when fully open ; petals then often somewhat recurved ; flowers open two days, only in bright forenoon sunshine. My specimens from the Rio Grande have 5 erect stigmata and a longer flower ; all the others have 6–8 spreading or even recurved stigmata and a shorter flower-tube. Berry about 4 lines in diameter. Withered flower finally deciduous. Fruit often bursting, when the filamentous red pulp and the black, thimble-shaped, verrucose seeds are seen. This pulp is formed by the clavate, elongated, twisted funiculi, which most probably form the pulp of all the soft Cactus fruits ; but they do not always remain as distinct as in this species.

E. TEXENSIS, Hœpf. *E. Lindheimeri*, Engelm. l. c. Mostly depressed, but sometimes globose. Common from the Colorado to the Rio Grande, and from thence to Saltillo (Dr. Gregg). Near New Braunfels it prefers the so-called Muskit-flats, or fertile level places with muskit-trees, overflowed in the rainy season. My specimens have several times fructified. Berry subglobose, pulpy, red, about 8 or 9 lines in diameter, covered with spiny bristles and soft wood, crowned by the woolly remains of the flower ; seeds reniform, compressed, large, smooth, and shining. Ribs in smaller specimens 13–14, in larger mostly 21, sometimes 24. Areolæ about 6 lines long and 12 lines apart. Spines from 6–10 lines long in some, 15–25 lines in others ; sometimes the central spine is 2 or 3 lines broad. Flowers all open within a few days, in May (in St. Louis) ; unlike the last-mentioned species.

CEREUS.

402. C. CÆSPITOSUS, Engelm. Plant. Lindh. l. c. Common about New Braunfels ; in flower in May. — This plant has been cultivated in Europe, as Prince Salm informs me, under the name of *Echinopsis Reichenbachiana*, Hortul., and has been confounded with *C. pectinatus*. Compare Wisliz. Rep. Appendix, note 45. [203] This species has also been sent from Saltillo by Dr. Gregg. Mr. Lindheimer has sent from the granitic region of the Liano a beautiful variety with chestnut-brown spines. *β.* CASTANEUS. — The characters given in Plant. Lindh. to this species have been corrected in Wisliz. Rep. l. c. I add here only that the fruit of this, as well as of all the other northern Cerei seen by me, ripens within a few weeks, — contrary to what is observed in our Mamillariæ and Opuntiæ, — and mostly bursts open longitudinally when ripe. — I cannot omit an interesting morphological observation made on this species. The usual structure of the flower of all Cerei observed by me is the

following. The ovary is covered with very short and (for the greater part) adnate sepals; the adnate part forms a protuberance (tubercle); the free part is mostly very small, often only a minute deciduous scale. In the axil of the scale we find the *areola*, covered with a short tomentuma, long wool, and almost always with bristles or spines. All this together forms the *pulvillus* of authors. Next in order follow those sepals which form the tube of the flower. The lower of these are entirely similar to the sepals on the ovary. In the upper or interior sepals the tip, or free part, becomes larger and larger, more herbaceous, and finally more or less petaloid; the wool and bristles become scarcer, but the latter longer, and are produced from an areola which is almost always situated in the axil of the sepal, where its free part separates from the common tube. Now, in *C. cæspitosus* the free upper part of these sepals of the tube is more and more elongated, somewhat terete, not foliaceous, and bears the areola with its wool and bristles just below the subulate or (in the innermost sepals) somewhat foliaceous tip, reminding us almost of the tubercles of a *Mamillaria*. The descriptions given in Plant. Lindh. and in Wisliz. Rep. have to be corrected accordingly.

C. PROCUMBENS, n. sp.: humilis; caule subtereti s. angulato articulato ramosissimo; tuberculis aculeiferis distinctis 4–5-fariis; areolis parvis orbiculatis, junioribus breviter albo-tomentosis; aculeis brevibus tenuibus [204] albidis apice fuscis, 5–6 radiantibus, centrali singulo erecto paulo longiore; floribus diurnis; ovario tuboque brevi pulvillis sub-40 albido-villosis setas spinescentes breviores fuscas 6–9 gerentibus stipato; sepalis interioribus sub-15 lineari-lanceolatis acuminatis; petalis 18–20 oblongo-linearibus acutis mucronatis subintegris (violaceis); stigmate viridi infundibuliformi 10-partito stamina (pallide flavicantia) paulo superante. — On the lower Rio Grande, below Matamoras, collected by the St. Louis Volunteers in 1846. — Plant spreading, 3–5 inches high. Joints or branches 1½–2 inches long, ½ inch in diameter, much contracted at the base. Tubercles 4 or 5 lines distant from one another, — often in 4 rows, whence the plant derives a distinctly quadrangular appearance; or in 5, when it is more cylindrical. Radial spines 6, or mostly only 5, the uppermost being frequently abortive, 1–1½ lines long; central spine 1½–2½ lines as long, stouter, directed upwards. Flower 3 inches long, and as wide when fully expanded, of a delicate purple color; petals 4 lines wide, often, in a bright noonday sunshine, recurved. Bristles on the tube about twice as long as the wool, below 1½–2, above 2½–3 lines long. — We have in gardens in St. Louis a similar species in cultivation under the name of *C. Deppii*, but, as Prince Salm informs me, widely different from the true *C. Deppii*. It is not known whence it was obtained. It is distinguished from *C. procumbens* by the larger, thicker, more cylindric limbs. Tubercles elevated, very distinct, in 5 or 6 rows; spines weaker and longer; 6–8 radial spines 5–6 lines long; ventral spine from 5 to 14 lines long; flower with a shorter tube, fewer pulvilli, with shorter wool but longer and weaker bristles.

C. RŒMERI, n. sp.: ovatus, e basi ramosus; costis sub-8 (7–9) tuberculatis interruptis; areolis orbiculatis, junioribus breviter tomentosis; aculeis albidis s. flavidulis demum cinereis teretibus, radialibus sub-8, centrali singulo robustiori porrecto; floribus diu noctuque apertis infundibuliformibus, limbo erectiusculo; sepalis ovarii et tubi 17 squamosis in axillis ex tomento albo brevissimo setas spinescentes albidas 3–5 gerentibus; sepalis [205] interioribus 8 ovato-oblongis carinatis obtusis mucronatis; petalis 10 obovato-spathulatis obtusis integris concavis chartaceis (coccineis); stylo longe supra stamina numerosissima exserto; stigmatibus 7 acutiusculis erecto-patulis viridibus. — Granitic region about the Liano; flowers (in St. Louis) in May. — Named after my friend Dr. F. Roemer, of the University of Bonn, who was the first to explore the geology of western Texas, and brought the first specimens of this species. Sent also in numerous specimens by Lindheimer. Heads 3–4 inches high, 1½–2½ inches in diameter, single, or mostly 3–5 or even 10 from the same base; ribs interrupted; areolæ 4–8 lines distant from one another; radial spines 5–12 lines long; lateral spines longest; upper ones usually shortest; central spine 10–15 lines long. Flower open by day and night for four or five, and in cool cloudy weather as much as six or seven days, 2 inches long and 1 wide; petals 8–9 lines long, 5 lines wide, stiff; bristles on the tube 2–3 lines long. — The stiff and almost pergamentaceous petals are uninfluenced by sunshine or darkness like those of most other Cactaceæ. Several other northern species most probably agree in this particular, as especially *C. coccineus* and *C. triglochidiatus* of New Mexico, while other nearly related species have certainly diurnal flowers. — *C. coccineus* differs by the more numerous ribs, more numerous spines, larger and more crowded areolæ, etc. *C. polyacanthus*, Engelm. in Wisliz. Rep., has more numerous spines, and 10 ribs; *C. enneacanthus*, Engelm. l. c., is larger, with the tubercles less distinct; 10 ribs; spines larger, angular.

C. VARIABILIS, Pfeiff., with its beautiful white nocturnal flowers, delighted our volunteers in their camps on the lower Rio Grande. Young plants are procumbent, with terete or rather clavate branches; adult plants several (3–10) feet high, mostly triangular, with very long and stout, or sometimes quite short spines. Fruit large, luscious, with red pulp; seeds large, smooth, shining.

OPUNTIA. [206]

§ 1. Applanatæ.

O. macrorhiza, n. sp.: prostrata; articulis obovato-orbiculatis planiusculis; pulvillis setis fuscis et sæpe aculeis singulis binisve instructis; aculeis teretibus validis porrectis s. paulo deflexis basi apiceque fuscis ceterum albidis cum adventitio inferiore graciliore reflexo sæpe deficiente; floribus sulphureis basi intus rubellis; ovario sepalis subulatis deciduis 13 in axillis setulas fuscas brevissimas gerentibus stipato; sepalis interioribus 15–18 subulatis et (internis) ovatis acuminato-cuspidatis; petalis 8 sepala superantibus late obovato-spathulatis obtusis cuspidatis eroso-denticulatis; stigmatibus 5 obtusis, adpressis, stamina numerosa æquantibus; bacca subpulposa clavata glabrata; seminibus marginatis. — Naked, sterile, rocky places on the Upper Guadaloupe. Flowers (in St. Louis) in June. Root a large and fleshy tuber, sometimes 2 or 3 inches in diameter; joints 3–4 inches long, about 2½–3½ wide, hardly attenuate at the base. Leaves subulate, about 5 lines long; areolæ ¾–1 inch distant, more crowded toward the base and on the edges; spines (often wanting) 1 inch long, the smaller 4–6 lines long. Flower 3 inches in diameter; ovary 1¼ inch long; petals 1 inch wide, 1½ inch long, pale yellow, red at the base. Fruit 1½ inches long; the strongly margined seeds comparatively few, 2½ lines in diameter. — I have found the same plant in similar situations in western Arkansas; and it is possible that it may be one of Nuttall's new species (*O. mesacantha, O. cæspitosa*, or *O. humifusa*) of which I cannot find a description. — Nearly related to *O. vulgaris*.

O. intermedia, Salm. The species mentioned in Plant. Lindh. l. c. No. 1, has since produced abundant flowers and fruit, and proves to be the above plant. It is near *O. vulgaris*, but more erect or ascending; the joints much larger; flowers larger (4½–5 inches in diameter); ovary more slender, 2–2¼ inches long, with 20–25 subulate sepals; petals obcordate; stigma 5-lobed, erect; fruit 2½ inches long, 6–8 lines wide at the top, deeply umbili- [207]
cate. Lindheimer's specimens are from Industry, south of the Brazos. I believe I have seen the same species near Natchitoches, on Red River.

O. Lindheimeri, n. sp.: erecta, robusta; caule lignoso; articulis (magnis) ellipticis basi attenuatis planis; pulvillis remotis ad margines confertioribus griseo-tomentosis, setis flavidis aculeisque paucis instructis 1–3 compressis validis deflexis varie divergentibus stramineis, nunc cum 1–2 aculeis adventitiis gracilioribus; flore . . . bacca clavata elongata subpulposa glabrata; seminibus late marginatis. — About New Braunfels. Plant erect, often 6–8 feet high; stems terete ligneous, sometimes 6 inches in diameter, with gray bark, and very light, spongy wood. Larger joints 9–12 inches long, 5–7 broad. Areolæ 1½–2 inches distant on old joints; bristles on them 1–3 lines long. Spines all pale yellow, much compressed, indistinctly annulated, ½–1 inch long, various; the 3 longer spines, or the 1 longer, with 1 or 2 shorter spines. The fruit which Lindheimer has sent as belonging to this species resembles very much that of *O. vulgaris*, 2–2½ inches long, slender, with a deep umbilicus, very different from that of the following species. Seeds 2–2¼ lines in diameter, not numerous. Young plants grown from this seed have the same compressed spines, but are brown at the base; the lower areolæ produce no spines, but a quantity of long, coarse hair. — I add here the following species, though not properly belonging to the flora of Texas, because I suspect that it is also found at the mouth of the Rio Grande, within the limits of Texas. There, and especially on the barren sand islands at the Brazos, near Point Isabel, the St. Louis Volunteers found large and impenetrable thickets formed by an Opuntia with large joints, covered with almost globose fruits, with innumerable small seeds and a very luscious deep red pulp. The fruit and seed are before me, but unfortunately I did not obtain a living specimen.

O. Engelmanni, Salm mss.: erecta; articulis orbiculato-obovatis planiusculis; pulvillis remotis ad [208]
margines confertioribus griseo-tomentosis setis flavidis aculeisque paucis compressis ancipitibus instructis, 1–4 validis sæpe inæqualibus plus minus deflexis varie divergentibus basi rufis, ceterum stramineis cum adventitio infimo graciliore albido sæpe deficiente; fl. . . . bacca ovata subglobosa late umbilicata pulvillis pluribus tomentosis stipata; seminibus minoribus anguste marginatis. — From El Paso to Chihuahua, indigenous and cultivated (Dr. Wislizenus). No doubt also on the Texan side of the Rio del Norte. — Erect, 5–6 feet high. Upper and larger older joints 12 inches long by 9 broad. Areolæ 1½–2 inches distant; bristles 2–6 lines long; spines 1–1¾ inches long, very stout. Fruit 1½–1¾ inches long, about 1½ in diameter; umbilicus large (10–12 lines), flat; pulvilli on the fruit about 5 lines distant. Seeds very numerous, about half as large as *O. vulgaris*, 1½–1¾ lines in diameter, of an irregular shape. — Near *O. Dillenii* and *O. polyantha*, as Prince Salm informs me.

§ 2. Cylindricæ.

O. frutescens, Engelm. in Plant. Lindh. l. c. under *O. fragilis*, from which it widely differs, stands near *O. gracilis*, Salm (raised from Mexican seeds), but is sufficiently distinct (Salm). Fruit by the abortion of the seeds very often sterile. — I had occasion to observe this species in blossom, and add the description of the flowers:

Floribus ex ramis anni prioris provenientibus; ovario clavato basi 5-gono sepalis subulatis sub-13 stipato; sepalis interioribus 8 lanceolatis ex viridi sulphureis; petalis 8 obovato-lanceolatis cuspidatis (sulphureis s. subvirescentibus);

staminibus numerosis (40–50) inæqualibus (externis majoribus); stylo exserto; stigmatibus 5 adpressis albidis. — The flower cannot be distinguished from that of the *Opuntiæ applanatæ*, but it is only 8–10 lines in diameter; ovary 9–12 lines long. Flowers (in St. Louis) July and August.

O. ARBORESCENS, Engelm. in Wisliz. Rep., is recognized by Prince Salm as identical with his *O. stellata;* but as no description of his plant has ever been published, he adopts the above name. [209]

IV. NOTES ON THE CEREUS GIGANTEUS OF SOUTHEASTERN CALIFORNIA, AND SOME OTHER CALIFORNIAN CACTACEÆ.

FROM THE AMERICAN JOURNAL OF SCIENCE AND ARTS, SECOND SERIES, VOL. XIV. NOV. 1852.

IN Emory's "Notes of a Military Reconnaissance," published in 1848 by order of Congress, I have ventured, from the data furnished by Colonel Emory, to describe one of the largest Cacti ever known. Since then several travellers have met with this giant of the Gila country, and have confirmed the extraordinary accounts of the first discoverer. But no further scientific details were obtained till Colonel Emory — now again in those regions as the chief of the scientific corps of the United States Boundary Commission — had occasion early this spring (1852) to send an expedition down the Gila River. Dr. C. C. Parry, who was connected with this party, paid particular attention to the Cacti of that region, and made it an especial object carefully to examine the *Cereus giganteus.* From his very full notes, kindly communicated by Colonel Emory, I have completed the description of the plant, with the exception of the flower and fruit, the account of which rests as yet on the verbal information obtained by Dr. Parry.

CEREUS GIGANTEUS, Engelm. in Emory's Rep. p. 158: erectus, elatus, simplex, sæpius parce ramosus; [336 (2)] ramis erectis caule cylindrico versus apicem sensim attenuato brevioribus; vertice parum depresso lanato; costis ad basin 12 versus apicem 18–20 rectis compressis obtusiusculis (versus basin obtusissimis) subrepandis; sinubus profundis angustis; areolis prominentibus orbiculatis albido-tomentosis; aculeis rectis, radialibus 11–17 brevioribus setaceis albis, centralibus 6 robustioribus longioribus (quorum imus robustissimus deflexus) tenuiter sulcatis albidis basi bulbosa nigris apice rubellis; floribus . . . bacca . . . seminibus oblique obovatis nigris lævibus lucidis.

Dr. Parry found this splendid species, which the Indians name "Suwarrow," in rocky crevices and on gravelly table-lands, from Tucson north to the Rio Gila; he learned that it also occurs in Central Sonora, near the heads of streams which empty into the Gulf of California. Colonel Emory observed it in 1846 from the middle towards the lower Gila; and Dr LeConte, who explored California in 1850, informs me that he found it "common along the Gila to within thirty miles of its mouth, where it suddenly disappears." It is no doubt the same plant of which Humboldt makes mention in his work on New Spain (II. p. 225), where he says that the Spanish missionaries found at the foot of the Californian Mountains nothing but sand or rocks, on which grew a cylindrical Cactus (Organos del Tunal) of extraordinary height.

Stems 25 to 60 feet high and 1 to 2 feet in diameter, not absolutely cylindrical, but thickest about the lower third, where generally the few (mostly 2–3) alternate or sometimes opposite branches start, and from thence slightly tapering toward the summit. Stems and branches marked by superficial transverse furrows, indicating, as it seems, the annual periods of growth, forming rings of 4 to 8 inches in height. Branches unequal, and always of less height than the main stem, mostly 5–10 feet long, with 12–18 ribs.

The stem consists of an exterior fleshy substance, 3–6 inches in thickness. This encloses a circle of bundles of ligneous fibres, corresponding with the intervals between the ribs. These bundles are of a loose texture, but tough and elastic, and form continuous columns or sticks of ½ to 3 inches in diameter, frequently anastomosing, increasing in thickness towards the base, and swelling into irregular, knotted, horizontally spreading roots. This frame-work remains after the decomposition of the fleshy parts. The exterior fleshy tissue passes between the bundles, and forms in the centre of the stems the pith, of 4–6 inches diameter.

The ribs are mostly vertical, at the base about 12 in number, broad, rounded, 4 inches or more wide, with broad and shallow intervals (also 4 or 5 inches wide), worn, and destitute of spines. Upwards [337 (3)] the number of ribs increases by bifurcation, or additional ribs originate in the intervals. There the ribs are "sharply rounded," 1½ inch wide, with deep intervals 2¼ inches wide, densely set with pines. Areolæ somewhat

elevated, circular, an inch distant from each other. Radiate spines ½–¾ inch long ; central spines stouter and longer ; the lowest deflexed, 1½–2½ inches long, the two next lateral, the three upper ones pointing upwards and outwards, and shorter.

Dr. Parry was informed that the flowers were produced in May and June, from the summit of stem and branches ; they are said to be white, with a red centre, and 3 inches in diameter. The fruit matures in August, and is set with small spines; it is obovate, 1½ inches in diameter, red, pulpy, of sweet taste. The seeds obtained by Colonel Emory and by Dr. LeConte have already been noticed in Emory's Report; they are 0.7 lines long, obovate, obliquely truncate at base, black, smooth, shining. Embryo hooked, without an albumen ; cotyledons foliaceous, unequal, incumbent.

My opinion that our plant is a true *Cereus*, and not a *Pilocereus*, which was based on the structure of the seeds (the foliaceous, not globose cotyledons), appears to be further confirmed by the fact that this Cactus bears no hair-like spines, and no *cephalium*, or distinct woolly head, and that the fruits are (as is said) spinulose and not scaly. It is by far the largest *Cereus* known, and only some *Pilocerei* approach it in size.

The only *Cactaceæ* thus far known to grow in California were those vaguely noticed by Humboldt (the "Organos del Tunal" and some Opuntiæ) ; the *Echinocactus viridescens* and *Cereus Californicus* discovered by Nuttall in 1834 ; the Cacti found on the Gila by Colonel Emory in the fall of 1846, and mentioned in his report ; *Mamillaria Goodrichii* — lately described by Scheer — of Kew ; and *Echinocactus Californicus* of Monville.

Dr. Parry has, in the years 1849 and 1850, when he was also attached to Colonel Emory's corps in the survey of the Mexican boundary, examined and described ten or eleven distinct species of Cactaceæ, all found along the southern boundary of California, from the sea-coast to the mouth of the Gila. He, as well as Dr. LeConte, states that much farther to the north no species of this family are found except an Opuntia, cultivated and now naturalized about the missions.

I subjoin here a short memorandum of Dr. Parry's Californian Cactaceæ, reserving a fuller description for a more extended memoir.

1. MAMILLARIA TETRANCISTRA, n. sp. : subglobosa ; aculeis radialibus brevibus albis numerosis, centralibus 4 longioribus cruciatis uncinatis ; floribus centralibus parvulis flavido-rubellis ; stigmatibus 3 ; [338 (4)] bacca coccinea pyriformi ; seminibus nigris hilo spongioso fusco auctis.

From San Diego to the junction of the Gila with the Colorado. — *M. Goodrichii*, Scheer, obtained on the island of Cerro, on the coast of California, is distinguished by the lower central spine only being hooked, by much smaller tubercles, etc.

2. ECHINOCACTUS VIRIDESCENS, Nutt. : depressed ; berry subglobose green, coated with lunate membranaceous scales. On dry hills and ridges near San Diego.

3. E. VIRIDESCENS, β.? CYLINDRACEUS, is distinguished by its oval or cylindrical shape, larger size, longer spines. Found near San Felipe, on the eastern slope of the California Mountains.

Note. — E. CALIFORNICUS, Monv., is the name of young plants raised from seed in Europe. I am informed that neither the identity nor the native country of these seedlings is satisfactorily known.

4. CEREUS EMORYI, n. sp.: caule prostrato ; ramis erectis cylindraceis 15-costatis ; aculeis radialibus 40–50, centrali singulo robustiore porrecto ; bacca globosa spinulosa.

In thick patches, on dry hills near the sea-shore, about the boundary line. Erect branches 6–9 inches high.

5. C. ENGELMANNI, Parry in litt.: caulibus pluribus pedalibus ; costis 13 tuberculatis ; aculeis 4 centralibus inæqualibus radiales tenuiores superantibus ; bacca ovali aculeata pulposa.

Mountains about San Felipe, on the eastern declivity of the Cordilleras.

Note. — C.? CALIFORNICUS, Nutt. in Torr. and Gray's Flora, is most probably a cylindraceous Opuntia, with "small yellow flowers," which I cannot now identify.

6. OPUNTIA ENGELMANNI, Salm. San Diego, on dry hillsides, in patches, 4 to 6 feet high. Originally discovered about Chihuahua, this species appears to extend westward to the Pacific.

7. O. TUNA, Mill., is cultivated for fences, and naturalized about the missions ; called "Tuña." It is 10–15 feet high ; the fruit large and edible.

8. O. PROLIFERA, n. sp. : caule erecto ligneo ; ramulis cylindricis tuberculatis divaricatis ; aculeis fuscis vaginatis ; bacca spinulosa.

San Diego, on arid hills and in dry creek beds. Plant 3–8 feet high, forming impenetrable thickets. Near *O. arborescens* of New Mexico; but the red flowers smaller, the berry spinous, etc.

9. O. SERPENTINA, n. sp.: procumbens; articulis cylindricis elongatis tuberculatis; aculeis 7–9 vaginatis; bacca sicca hemispherica aculeatissima.

Dry hillsides, San Diego.

10. O. RAMOSISSIMA, n. sp.: caule erecto ligneo divaricato-ramosissimo; articulis gracilibus cylin- [339 (5)]
dricis tuberculatis cæsiis; aculeis subsolitariis saccato-vaginatis; bacca sicca tuberculata setosa et aculeata.

Gravelly soil near the Colorado, and in the desert. Plant 2 feet high; the joints ½ inch in diameter. Approaches the Opuntia cylindraceæ graciliores.

11. O. PARRYI, n. sp.: caule prostrato; articulis adscendentibus tuberculatis; setis fuscis; aculeis brevibus albidis, singulo longiore deflexo; bacca subglobosa setoso-aculeata.

Eastern slope of the California Mountains, near San Felipe. Joints 4 to 8 inches long; the longest spines ½ inch long. Flower 1½ inch in diameter, yellowish green. Approaches the Opuntiæ clavatæ.

Mr. Charles Wright, well known to the botanical world by his collections made in the southwest, now also attached to the Mexican Boundary Commission, has, under the instruction of Colonel Graham, made large and interesting collections of Cacti in western Texas and southern New Mexico, and sent them to me for examination.

It is impossible here to give as full an account of them as would be desirable; but most of them are now in cultivation, and will be described hereafter. Most of the Cactaceæ discovered by Wislizenus, Fendler, and Gregg are among them, together with a considerable number of new species. I will here only state that my doubts in regard to the fruit of *Cereus Greggii*, expressed in my account of the plant in Emory's Report, have been entirely dispelled by Mr. Wright. He says that the plant is large, much branched, has a very large fleshy root, generally implanted in hard stony soil, and the pulpy scarlet fruit is just as figured in Emory's Report, — stiped at base and attenuated above. The seeds he sends are black and opaque, rugose and pitted, about 1 line in diameter. They have germinated well with me. This same plant has been sent from Chihuahua to Kew by Mr. Potts, and has been described by Prince Salm as *Cereus Pottsii*, — which name, however, must give way to the prior name, *C. Greggii*. It is every way a very singular plant, and though found from western Texas and Chihuahua to El Paso, the copper mines, and the lower Gila, appears to be rare everywhere.

[The following observations, sent in as a substitute for a sentence on p. 339, but received too late for insertion at that place, were printed on p. 446 of the same number. — EDS.]

The curious *Cereus Greggii*, E., has been noticed from the Pecos River east to the Mimbres Mountains west of El Paso, and from Chihuahua towards the mouth of the Gila, but always in isolated specimens, very scattering and rare. The fruit which was figured in Emory's Report is deep scarlet, succulent, with short spines on the pulvilli; it is oval, sessile, and attenuated at base, and *not stipitate*, but long acuminate, and with the long tube of the flower curved downwards, remaining attached to its point. The seeds are black and opaque, rugose and pitted, and about 1 line in diameter. The root is large, turnip-shaped, and produces many stems, 2–4 feet high. The young plants raised from seeds are dark purplish, triangular; root not yet enlarged.

Collections of Cactaceæ have also been recently made by Dr. John M. Bigelow of the Boundary Commission, who has sent them to me for examination. My collection under study includes about 12 species of Mamillaria, 8 Echinocacti, 12 Cerei, and 12 Opuntiæ, most of which are new forms.

ST. LOUIS, Sept. 7, 1852.

V. FURTHER NOTES ON CEREUS GIGANTEUS OF SOUTHEASTERN CALIFORNIA WITH A SHORT ACCOUNT OF ANOTHER ALLIED SPECIES IN SONORA.

From the American Journal of Science and Arts, Second Series, Vol. XVII. March, 1854.*

Specimens of flowers and fruit, together with interesting notes and drawings communicated by Mr. George Thurber, and specimens of ribs of the plant with spines presented by Dr. Parry, enable me to perfect the history of this giant Cactus. Mr. Thurber travelled through the Gila country and Sonora, as one of Mr. Commissioner Bartlett's party, in the summer of 1851, and is believed to be the only scientific gentleman who has seen the plant in question in flower. These materials enable me to furnish the following detailed character.

Cereus giganteus, Engelm.: erectus, elatus, simplex, s. ramis paucis erectis caule cylindrico versus apicem sensim attenuato brevioribus candelabriformis; vertice applanato tomentoso; costis ad basin caulis sub-12 versus apicem 18–20 rectis obtusis (vetustioribus ad caulis basin obtusissimis) subrepandis; sinubus ad basin caulis latissimis versus apicem profundis angustioribus angustissimisque; areolis prominentibus ovato-orbiculatis junioribus albido-tomentosis; aculeis rectis basi valde bulbosis tenuiter sulcatis angulatisque albidis demum cinereis, radialibus 12–16 imo summisque brevioribus, lateralibus (præcipue inferioribus) longioribus robustioribus subinde cum aculeis adventitiis paucis setaceis summo areolæ margini adjectis; aculeis centralibus 6 robustis albidis basi nigris apice rubellis demum totis cinereis, 4 inferioribus decussatis quorum infimus longissimus robustissimus [232 (2)] deflexus, 2 superioribus lateralibus brevioribus; floribus versus apicem caulis ramorumque sparsis, tubo ampliato breviusculo petalisque patulis; ovario ovato sepalis 25–30 squamiformis triangulatis acutis in axilla fulvo-villosis stipato; sepalis tubi sub-30 orbiculato-subtriangularibus mucronatis, inferioribus in axilla lanigeris, superioribus nudis, sepalis intimis 10–15 spathulatis obtusis carnosis (pallide viridibus albescentibus); petalis sub-25 obovato-spathulatis obtusis integris crispatis coriaceo-carnosis crassis (flavescenti-albidis); staminibus numerosissimis, filamentis superiori tubi parti adnatis (inferiore nudo); stylo stamina paulo superante; stigmate multifido; bacca obovata squamis sepaloideis triangularibus carnosis minutis ad axillam fulvo-lanatis stipata, pericarpio duriusculo carnoso, demum valvis 3–4 patentibus reflexisve dehiscente; seminibus numerosissimis in pulpa saccharina nidulantibus oblique obovatis lævibus lucidis exalbuminosis; embryone cotyledonibus foliaceis incumbentibus hamato.

This species ranges from north of the Gila River southwardly into Sonora, to within 20 miles of Guaymas on the Californian Gulf. It doubtless also occurs on the Peninsula of California; where, according to Vanegas in his history, published about one hundred years ago, the fruit of a great Cactus forms an important article of food to the natives of the eastern coast, the harvest time of which was a season of great festivity. The flowers are produced in May and June, and the fruit ripens in July and August. Mr. Thurber collected the last flowers and the first ripe fruit in the beginning of July. He has collected abundance of seed, and will be pleased to communicate it to those who take an interest in the cultivation of Cacti. The youngest plants Mr. Thurber noticed were three or four feet high, with narrow furrows and long spines; the smallest flowering plants were about 12 feet high, and the tallest specimens observed appeared to reach the elevation of 45 or 50 feet.

The ligneous fascicles correspond with the intervals between the ribs, and not with the ribs themselves; of which Dr. Parry has fully satisfied himself, and which indeed is the case in all ribbed Cacti. From between these bundles ligneous fibres radiate horizontally towards the ribs, and especially to the areolæ.

At the base of the stem the ribs are broad and obtuse, with wide and shallow intervals; upwards the ribs are somewhat triangular, rounded or obtuse, with deep and acutish grooves between them; towards the top of the plant the ribs are equally obtuse, but quite compressed, and the grooves are deep and narrow.

The elevated areolæ are 7 lines long, nearly 6 lines in diameter, about an inch distant from one another, sometimes more closely approximated.

Lowest and upper radial spines 6 to 12 lines long, sometimes the upper ones with a few additional, [233 (3)] shorter, flexuous, setaceous spines: lateral ones 12–18 lines long, the lower ones longest; the four lower central spines straight or very slightly curved downwards, 20–30 lines long; the two upper central spines 15 to 18 lines long. The stoutest spines are one line in diameter, their bulbous base being fully twice as thick. The old spines together with the whole areola readily come off in one bunch, but generally the 6 central spines fall off first, leaving the radiating ones appressed to the stem, till finally they also fall away.

* See this Journal, New Series, vol. xiv., page 335, November, 1852. A translation of these notes appears in the Botanische Zeitung for 1854, pp. 616–620. — Eds.

The flowers are produced near the summit of the plant, but not on it, and the fruit is usually 6–12 inches from it. The dried flower communicated by Mr. Thurber is 3 inches long; but the drawing represents the flowers as fully 4 inches in length and diameter. The ovary in the dried specimen is $\frac{3}{4}$ of an inch long; the lower naked part of the tube 1 inch, the upper staminiferous much widened part $\frac{3}{4}$ of an inch long. Upper sepals fleshy, greenish white, $\frac{3}{4}$ of an inch long, below 2, above 4 lines wide. Petals of a light cream color, an inch long, 6–7 lines wide above, very thick and fleshy, and very much curled. Filaments light yellow, adnate to the upper half of the tube: anthers 0.8 to 0.9 of a line long, linear, emarginate at the base and apex. Style not seen; the drawing represents the numerous (15–20 ?) stigmata as half an inch long, suberect, of a green color. The flowers appear to be open night and day, and probably for several days in succession.

The fruit sent by Mr. Thurber (in alcohol) is obovate $2\frac{1}{2}$ inches long, by $1\frac{1}{2}$ in diameter, beset with about thirty scales, having short brownish wool in their axils, but entirely destitute of spines. Mr. Thurber informs me that this specimen is unusually long: the fruit, he says, is usually 2 or 3 inches long by $1\frac{1}{2}$ to 2 in diameter; the color is green, reddish towards the summit; the remains of the flower fall off, leaving a broad and convex scar. The pericarp has the hardness of a green cucumber, somewhat softer towards the apex, and is about 2 lines thick: it bursts open on the plant with 3 or mostly 4 irregular, interiorly red valves, which spread horizontally, and appear like a red flower when seen at a distance, which accounts for the report of this species having red flowers. The crimson-colored and rather insipid pulp has the consistency of a fresh fig; it completely separates from the rind, and drying up from the heat of the sun, falls to the ground, or is beaten down, when it is collected by the natives and rolled into balls, which keep several months, or is pressed for the thick molasses-like saccharine juice which it contains. The innumerable seeds are 0.7 to 0.8 lines long.

Another, apparently nearly allied species, was collected in Northern Sonora. From the half of a flower before me, together with Mr. Thurber's meagre notes (other specimens unfortunately having been [234 (4)] lost), I have ventured to make out the following description:

CEREUS THURBERI, n. sp.: erectus, elatior, e basi ramosus sub-14-costatus, sulcis parum profundis, aculeis brevibus nigricantibus; floribus tubuloso-campanulatis virescenti-albidis; ovario globoso sepalis 80–100 carnosis squamiformibus triangularibus acutis imbricatis ad axillam villosis stipato; sepalis tubi inferioribus 24 lanceolatis acutiusculis axilla nudis, superioribus 20–25 orbiculato-obovatis obtusis; petalis 16–20 obovato-spathulatis obtusis crassis.

Collected in June 1851, in a rocky cañon near the mountain pass of Bacuachi, a small town on the road to Arispe, in Sonora; afterwards found with *Cereus giganteus*, near Santa Cruz: it abounds also near Magdalena and Ures. Santa Cruz appears to be the northern limit of this species, which does not extend to the Gila River. Stems 4 to 12 feet high, many from the same base, 6 to 10 inches in diameter, sometimes articulated, occasionally branching above, with about 14 ribs and shallow grooves. Flowers greenish-white, borne about a foot below the summit of the stem. Dried flower $2\frac{3}{4}$ inches long; the tube narrower, and more elongated than in *C. giganteus;* the globose ovary and the naked and staminiferous part of the tube each about $\frac{3}{4}$ inch long; free part of petals of the same length, and 4 lines wide. Anthers much larger than in the foregoing species, 1.3 to 1.4 line long. Style not seen.

I have dedicated this to the collector, Mr. George Thurber, of Rhode Island, an excellent botanist, who has kindly furnished me with the materials for this article.

Cereus Thurberi and *C. giganteus* appear to be closely allied species. They have high and erect stems, flowers with a short tube, half of which is naked, the filaments occupying only the upper half of the tube; both have short and fleshy sepals on the ovary, with short wool in their axils, unaccompanied by any bristles or spines; in both the petals are whitish, obtuse, and fleshy.

Both, and especially *C. giganteus*, stand very near the *Pilocerei* on account of the great height of the stem, the short ventricose tube of the flower, and the thick petals; but they have not the least indication of a *cephalium* (or woolly head) nor of any particular development of wool; their flowers spring from the axils of the ordinary and unaltered areolæ; and the seed is quite different, at least from that of *Pilocereus senilis*, the only species of that genus, I believe, which has been well examined; these seeds are said to be obliquely thimble-shaped, densely dotted, and to have an embryo with thick globose cotyledons. It is also said that the filaments cover the whole inside of the tube of the flower, and even the free upper part of the ovary. In all the *Cerei* and *Echinocacti* [235 (5)] examined by me, I find the lowest part of the tube free, the filaments being adnate to some distance above the ovary. It is not improbable that the Chilian velvety *Cerei* (*Velutini*, Pr. Salm.) are to be classed near our species. The flower of what appears to be *Cereus Chilensis*, Pfr., obtained near Valparaiso, and figured by the artist of the U. S. Exploring Expedition, greatly resembles that of *C. Thurberi:* it is a little larger, but has the same shape, and the same closely imbricated sepals on the ovary; the tube has about 100 sepals, and the white petals are acute; whether fleshy or not is uncertain.

VI. SYNOPSIS OF THE CACTACEÆ OF THE TERRITORY OF THE UNITED STATES AND ADJACENT REGIONS.

From Proceedings of the American Academy of Arts and Sciences, Vol. III. 1856.

The only Cactus known to Linnæus from the countries north of Mexico was his *Cactus Opuntia* (*Opuntia vulgaris*). Long after him, more than forty years ago, Nuttall, the pioneer of West American botany, discovered two *Mamillariæ* and two *Opuntiæ* on the Upper Missouri, and again, twenty years later, in California, a new *Echinocactus*. About ten years ago we became acquainted with numerous new Cactaceæ, in Texas through Mr. F. Lindheimer; in New Mexico through Dr. A. Wislizenus; and in northern Mexico through the same explorer and Dr. J. Gregg: some others (and among them the giant of Cacti) were indicated in the Gila country by the then Lieutenant W. H. Emory. Soon afterwards Mr. A. Fendler collected several new species about Santa Fé. Mr. Charles Wright, a few years later (1849), discovered in western Texas and southern New Mexico still other undescribed Cacti.

But the greatest addition to our knowledge of the Cactaceæ of the southern part of the United States was made by the gentlemen connected with the United States and Mexican Boundary Commission, at first under Colonel Graham, and subsequently under Major Emory. Science is indebted principally to Dr. C. C. Parry, Mr. Charles Wright, Dr. J. M. Bigelow, Mr. George Thurber, and Mr. A. Schott, for valuable collections of living as well as dried specimens, and for full notes taken on the spot. About the same time, M. A. Trécul of France, and after him Dr. H. Poselger of Prussia, traversed southern Texas and northern Mexico, collecting many Cactaceæ, and increasing our knowledge of this interesting branch of botanical science.

The Pacific Railroad expeditions since 1853 have opened fields not before explored; [260] and Dr. Bigelow, the botanist and physician of Captain A. W. Whipple's expedition along the 35th Parallel, availed himself of these opportunities in a most successful manner; while Dr. F. V. Hayden, almost unaided in his adventurous expedition, has extended our knowledge of the northernmost Cactaceæ in the regions of the Upper Missouri and Yellowstone Rivers.

The last, but by no means least addition, was made in 1854 and 1855, by Mr. Arthur Schott, during the exploration under Major Emory of the country south of the Gila River, known as the Gadsden Purchase.

Most of the materials brought together by these different explorers have come into the hands of the writer; but few of the discoveries made since 1847 and 1848 have been given to the public, — partly because the material on hand very often was incomplete, and partly because it seemed desirable to publish the whole in an elaborate form with the Reports of the Boundary Commission and those of the Pacific Railroad Surveys. These reports are now in preparation; but the splendid plates which are to illustrate the natural history of these plants cannot be finished for some time; it is therefore deemed advisable now to publish short descriptions of the new species, and systematically to arrange them with those before known.

CACTACEÆ.

Tribus I. TUBULOSÆ, Miquel.

Subtrib. 1. Parallelæ. — Cotyledones margine hilum versus spectantes, lateribus seminis parallelæ.

I. MAMILLARIA, Haw.

Ovarium baccaque læves. Semina fere exalbuminosa. Cotyledones abbreviatæ, plerumque erectæ, subconnatæ. — Plantæ mamillato-tuberculatæ; inflorescentia laterali s. verticali.

Subgen. 1. Eumamillaria. Flores ex axillis tuberculorum anni prioris nunquam sulcatorum: ovarium plerumque immersum versus fructus maturitatem emergens.

§ 1. Polyacanthæ, Salm.

1. M. micromeris, E. in Bound. Comm. Rep. : parvula, simplex, globosa ; tuberculis minimis verrucæformibus confertissimis ; areolis junioribus solum lana laxa vestitis ; aculeis setiformibus cinereis pluri- [261]
seriatis, in plantis junioribus sub-20 æqualibus lineam longis, radiantibus in tuberculis floriferis 30–40 undique stellato-porrectis, superioribus 6–8 longioribus clavatis ; floribus minimis subcentralibus.

Var. β. Greggii : *major, tuberculis majoribus aculeis paucioribus rigidioribus.*

From El Paso eastward to the San Pedro River. Var. β. near Saltillo. From ½ to 1½ inches in diameter ; β. often 2 inches or even more in diameter ; tubercles ½–1 line long, spines ½–1½ lines long, in β. 1–2 lines long ; uppermost spines of each areola in the fully developed plant 3 to 4 times as long as the others, and strongly clavate, surrounded by long and loose wool, which, together with the upper part of the long spines, breaks or falls off after fructification. Flowers (and even fruits) nearly central, 3 lines in diameter, light pink. — Near *M. microthele*, Muhlenpf. which, however, has 2 central spines.

2. M. lasiacantha, E. l. c. : parvula, simplex, globosa ; tuberculis teretibus ; aculeis setiformibus pilosulis s. denudatis 40–80 pluri-seriatis omnibus radiantibus ; floribus lateralibus albidis.

On the Pecos River, in Western Texas : fl. in May. — Plant ½ to 1 or even 1½ inches high, and scarcely less in diameter; tubercles 2–3 lines long, spines 1½–2½ lines long. Flower whitish or very pale pink, 6 lines long. — *M. Schiedeana*, Ehrenb. seems to be similar, but is much larger, and has large tubercles with woolly axillæ, etc.

§ 2. Crinitæ, Salm.

A. *Aculeis centralibus rectis.*

3. M. pusilla, DC., var. Texana, E. l. c. : ovato-globosa, prolifera, cæspitosa ; tuberculis teretibus axilla longelanatis ; aculeis pluri-seriatis, extimis 30–50 capillaceis crispatis, interioribus 10–12 rigidioribus brevioribus albidis, intimis 5–8 longioribus rigidis rectis versus apicem fuscatis ; floribus lateralibus rubellis.

On the Rio Grande, near Eagle Pass and southward : fl. April–June. — Plant 1–2 inches high ; spines 3–6 lines, flowers 7–10 lines, long. — Seems scarcely distinct from the well-known West Indian *M. pusilla.*

B. *Aculeis centralibus uno alterove uncinato.*

4. ? M. barbata, E. in Wisl. Rep. : aculeis radialibus biseriatis, centrali singulo deorsum hamato ; floribus subcentralibus ; seminibus tenuiter scrobiculatis.

Cosiquiriachi, west of Chihuahua. This species has borne flower and fruit with me, and my notes [262]
and my recollections indicate that they were central : hence the mark of doubt above, as to the proper position of this species here, where all the other closely allied forms belong.

5. M. phellosperma, E. in B. C. R. (M. tetrancistra, E. in part, Sill. Journ. Nov. 1852) : ovata, subsimplex ; tuberculis teretibus axilla lanata setigeris ; aculeis radiantibus 40–60 biseriatis, exterioribus brevioribus tenuioribus, centralibus 3–4 robustioribus atrofuscis inferiore s. pluribus hamatis ; floribus lateralibus ; bacca pyriformi subsicca coccinea ; seminibus globosis rugosis nigris massa fusca suberosa majore arilliformi auctis.

From the Gila to the Eastern slope of the California mountains. — The name originally given had to be altered, because very rarely, if ever, are 4 hooked spines seen. In the original description this and the next species were confounded. — Plant 2–4 inches high. Radial spines 4–6 lines, central ones 5–9 lines long. — Apparently near *M. ancistroides*, Lem., which, however, has the radial spines all homogeneous.

6. M. Grahami, E. l. c. : subglobosa, simplex s. demum e basi ramosa ; tuberculis ovatis, axilla nudis ; aculeis radiantibus 20–30 uniseriatis, centrali sursum hamato fuscato, additis sæpe 1–2 superioribus rectis ; floribus lateralibus rubicundis ; bacca ovata virescente ; seminibus minutis scrobiculatis nigris.

Mountains from El Paso southward and westward to the Gila and Colorado, and up the latter river : fl. from June or July to August. — Plant 1–3 inches high ; hooks much longer than the radial spines, which are 3–6 lines long. Flowers below the top, nearly one inch in diameter. Berry and seed small, the latter only 0.4 line long.

7. M. Wrightii, E. l. c. : depresso-globosa, simplex ; tuberculis teretibus axilla nudis ; aculeis radiantibus sub-12 albidis ; centralibus sub-binis uncinatis fuscis vix longioribus ; floribus lateralibus (?) purpureis ; bacca subglobosoovata majuscula ; seminibus scrobiculatis nigris.

New Mexico, on the Pecos and near the Copper Mines. — Plants 1½–3 inches in diameter. Spines 4–6 lines long. Flowers fully one inch in diameter, bright purple, with narrow acuminate petals. Berry large and purple : seed 0.7 line long.

8. M. Goodrichii, Scheer : ovato-globosa, subsimplex ; tuberculis brevi-ovatis axilla lanata setigeris ; [263]
aculeis radiantibus 11–15 albidis, centralibus 3–4 fusco-atris, inferiore paulo longiore deorsum uncinato ; floribus lateralibus.

San Diego, California. — Two or three inches high. Radial spines 2½–3½ lines long; the lower central spine a little longer. Flowers apparently yellowish-white, and half an inch in diameter.

§ 3. SETOSÆ, Salm.

9. M. BICOLOR, Lehm.: depressa, ovata, s. cylindracea, prolifera; axillis lanatis; tuberculis parvulis conicis; aculeis exterioribus 16–20 tenuissimis recurvato-radiantibus, centralibus 2–4 rigidis, majoribus albis apice nigris interdum subpollicaribus, supremo plerumque longissimo incurvo; floribus parvulis purpureis; stigmatibus 5.

Abundant on the calcareous hills of the Rio Grande below Laredo, Texas, Dr. Poselger: fl. June and July. — Plant 3–12 inches high, the larger specimens 2–3 inches in diameter; radial spines 1–2, lower central ones 4–5, the upper 6–10 lines long. Flower about 9 lines long.

§ 4. CENTRISPINÆ, Salm. (All our species are simple and have a milky juice.)

10. M. HEYDERI, Muhlenpf. (1848): simplex, depresso-globosa; tuberculis elongatis pyramidatis subquadrangulatis; aculeis radiantibus 10–20 rectis, inferioribus longioribus, centrali singulo breviore; floribus lateralibus sordide rubellis; baccis elongato-clavatis; seminibus parvis rugulosis fulvis.

Var. *α*. APPLANATA (M. applanata, E. in Pl. Lindh. 1850): vertice applanato s. depresso, aculeis radialibus 15–22.

Var. *β*. HEMISPHÆRICA (M. hemisphærica, E. l. c.): vertice convexo, aculeis radialibus 9–12.

From San Antonio and New Braunfels, Texas, to Matamoras and westward to El Paso: fl. April, May. — Var. *α*. is the Northern and Western, and *β*. the Southern form. — *M. declivis*, Dietr. seems to belong here; but I have never met with a description of this plant.

11. M. MEIACANTHA, E. in B. C. R.: hemisphærica; tuberculis quadrangulato-pyramidatis compressis; aculeis paucis (5–9) rigidis rectis s. recurvatis, inferioribus paulo longioribus, centrali singulo erecto s. sursum flexo et cum cæteris radiante; floribus et baccis præcedentis.

Western Texas and New Mexico. — Very similar to the last; but tubercles larger, more compressed, more loosely arranged; the spines fewer and stouter; perhaps only a variety of it.

12. M. GUMMIFERA, E. in Wisl. Rep. Similar to the last two, but stouter; flower larger, darker, but otherwise little different. Radial spines 10–12; the lower ones much stouter and longer than the upper ones: central spines 1 or 2, shorter. [264]

§ 5. LONGIMAMMÆ, Salm.

13. M. SPHÆRICA, Dietr.: prolifera, cæspitosa; tuberculis ovato-elongatis acutatis; aculeis setaceis radialibus 12–14, centrali singulo subbreviore vix robustiore; floris magni tubo supra ovarium emersum constricto elongato; petalis flavis acuminato-aristatis.

Hill-sides on the Rio Grande near Eagle Pass; also Corpus Christi, on the Gulf. — Single specimens clavate, but often forming dense hemispherical masses. Tubercles 6–8 lines, spines 3–5 lines long. Flower 1½–2 inches long. Fruit not seen.

Subgen. 2. CORYPHANTHA. Flores e basi tuberculorum hornotinorum aculeiferorum sulcatorum, vel in vertice ipso oriundi: ovarium emersum.

§ 1. ALBIFLORÆ.

14. M. PAPYRACANTHA, E. in Pl. Fendl. (Mem. Amer. Acad. 1849). This interesting plant has been collected only in a single specimen, near Santa Fé, which, together with the dried flowers, is in my possession. Shape of tubercles not well distinguishable, doubtful whether sulcate or not; the lower ones proliferous. Spines compressed, flexible, of the consistency of stiff paper; 8 radiating and 3 or 4 central; the lowest one of these longest and broadest. Flowers white, central, an inch or more in length and width. Fruit not seen.

§ 2. FLAVIFLORÆ.

* *Laxifloræ*. (The originally central flowers are pushed aside by the continuous development of new tubercles.)

15. M. NUTTALLII, E.: simplex s. prolifera, cæspitosa; aculeis radialibus 10–17 setaceis rectis plerumque puberulis albidis, centrali singulo robustiore sæpius deficiente; sepalis fimbriatis et petalis flavidis apice parce denticulatis lanceolatis, s. lineari-lanceolatis acutis; stigmatibus 2–8 erectis vel patulis; bacca subglobosa tuberculis breviore coccinea; seminibus globosis scrobiculatis nigris.

Var. *α*. BOREALIS (M. Nuttallii, E. l. c. Cactus mamillaris, Nutt. Gen., 1818, *non L.*): subsimplex; aculeis setaceis 13–17 cum centrali sæpe deficiente puberulis; stigmatibus 2–5; baccis seminibusque minoribus.

Var. *β*. CÆSPITOSA (M. similis, E. in Pl. Lindh. 1845): cæspitosa; aculeis radialibus 12–15 puberulis, centrali plerumque deficiente; floribus baccis seminibusque majoribus; stigmatibus 5 patulis. [265]

Var. γ. ROBUSTIOR, E. in Pl. Lindh. 1850: subsimplex; tuberculis longioribus laxioribus, aculeis robustioribus lævibus, radialibus 10–12, centrali singulo; floribus majoribus; stigmatibus 7–8 patulis; seminibus ut in β.

Plains east of the Rocky and New Mexican Mountains. Var. α. on the Upper Missouri; β. from Kansas River to New Braunfels in Texas; γ. from the Canadian River to the Colorado of Texas. The heads are one or two inches in diameter; the cæspitose masses of β. often a foot broad; spines 3–8 lines long. Flowers 1–2 inches long and wide, of a greenish or reddish or pure pale-yellow color. Seeds 0.8–1.1 line in diameter, more regularly globose than in most other Cactaceæ.

16. M. SCHEERII, Muhlenpf. 1847; β. ? VALIDA, E. in B. C. R.: magna, ovato-globosa, subsimplex, glaucescens; tuberculis remotis patulis magnis e basi lata subcylindricis supra sulco profundo glandulis paucis munito (juniore lanato) subbilobis; areolis junioribus dense lanatis; aculeis 10–20 rectis robustis basi bulbosis albidis s. citrinis apice fuscatis, radialibus 9–16; centralibus 1–5 validioribus angulatis; floribus flavis ex axillis junioribus tomentosissimis.

Sandy ridges in the valley of the Rio Grande near El Paso: fl. July. The largest of our Northern Mamillariæ, 7 inches high and 5 in diameter; tubercles 1–1½ inches long; spines 10–18 lines in length, very stout, especially the central and lower radial ones. Flower 2 inches long, yellow. Fruit not seen. — *M. Scheerii* from Chihuahua, according to Prince Salm's description, is a smaller plant, with single central spines one inch in length, and 8–11 much shorter radial spines; the areolæ are described as naked: — nevertheless our plant is probably only the Northern form of this species.

17. M. ROBUSTISPINA, A. Schott, in litt.: simplex s. cæspitosa; tuberculis patulis teretibus magnis sulcatis; areolis junioribus dense tomentosis; aculeis radialibus 12–15 robustis inferioribus robustioribus sæpe curvatis, superioribus rectis fasciculatis paullo tenuioribus, centrali singulo valido compresso recurvato, omnibus subpollicaribus corneis apice atratis; floribus luteis ex axillis junioribus tomentosissimis; seminibus magnis obovatis fuscis lævibus.

Sonora, on grassy prairies: fl. July. Tubercles nearly an inch long, and an inch distant from one an- [266] other; spines 9–15 lines long. Flowers 2 inches long, characterized by a very slender, constricted tube, very different from the wide tube of the foregoing species. Seeds fully 1½ lines long, larger than those of any other Mamillaria examined by me: embryo with some albumen, curved; cotyledons foliaceous! approaching the structure of the seed of most Echinocacti.

18. M. RECURVISPINA, E. in B. C. R.: simplex, depresso-globosa; tuberculis ovatis profunde sulcatis confertis; areolis obliquis ovatis, aculeis radialibus 12–20 rigidis recurvis intertextis albidis corneisve, aculeo centrali singulo (raro binis) robustiore longiore decurvato; floribus flavicantibus extus fuscatis ex axillis junioribus villosissimis.

Sonora: fl. July. Single heads 3–8 inches in diameter; tubercles 5–6 lines long; spines 4–9 lines long, upper ones often a little longer than the lower ones; central spine 6–10 lines long, darker. Flowers 1½ inches long. — This plant bears the closest resemblance to the next species, and must perhaps be classed with it; but in the dry specimen before me the flowers are not exactly vertical, as in that species.

* * *Densiflorœ.* (Flowers and fruit remain central in the very woolly vertex of the plant, no new tubercles being developed before the fruit falls off; berries of all the species known to me oval, green; seeds brown, smooth.)

19. M. COMPACTA, E. in Wisl. Rep.: simplex, depresso-globosa; tuberculis abbreviato-conicis sulcatis confertis; areolis ovato-lanceolatis, aculeis radialibus 13–16 rigidis recurvis intertextis albidis corneisve, aculeo centrali erecto plerumque deficiente; floribus flavis extus fuscatis minoribus.

Cosiquiriachi, west of Chihuahua: fl. June and July. Plant 2–4 inches in diameter; distinguished from the last species by the acutish (not obtuse) tubercles, the more elongated areola, the erect central spine, which however is wanting in most specimens, and principally by the smaller and truly vertical flowers. Spines 5–10 lines long; flower 1¼–1½ inches long and wide; seed 0.7 line long.

20. M. PECTINATA, E. in B. C. R.: simplex, globosa; tuberculis conicis abbreviatis, summis floriferis teretibus longioribus sulcatis; areolis oblongis; aculeis 16–24 rigidis recurvis intertextis subæqualibus s. in tuberculis summis superioribus longioribus fasciculatis omnibus radiantibus corneis s. albidis; floribus magnis sulphureis.

On the Pecos River, in Western Texas: fl. July. — Plant 1–2 inches in diameter. Lower tubercles 2–3, [267] floriferous ones 5–6 lines long; spines 3–5, upper fasciculated ones 6–9 lines long. Flower 2½–3 inches in diameter; seed 0.9 line long.

21. M. ECHINUS, E. l. c.: simplex, globosa; tuberculis tereticonicis; areolis orbiculatis; aculeis rectis s. paullo curvatis intertextis albidis; radiantibus 16–30 summis paullo longioribus, centralibus 3–4, inferiore robustissimo subulato porrecto, superioribus 2–3 et cum radiantibus erectis; floribus magnis.

With the former. — Plant 1½–2½ inches in diameter; tubercles 5–6 lines long; lower and lateral spines 4–6, upper ones 6–10 lines long; upper central spines of the same length, and the lower central one a little shorter. This last one is unusually stout, subulate from a very thick base, and perpendicular on the centre of the plant, which gives it a very peculiar aspect. Flowers apparently about 1½ or 2 inches long.

22. M. SCOLYMOIDES, Scheidw. (1841) : globosa s. ovata, subsimplex; tuberculis conicis, superioribus elongatis incurvis imbricatis ; aculeis radiantibus 14–20 rectis s. plerumque recurvis albidis s. corneis, superioribus longioribus, centralibus 1–4 longioribus obscurioribus curvatis, superioribus sursum versis cum radialibus implicatis, inferiore robustiore longiore decurvo.

South of the Rio Grande; not yet discovered in our territory. — Plant 2–3 inches high ; tubercles 5–8 lines long ; radial spines 5–10 lines, the central ones 9–16 lines long. Flowers yellow, 2 inches long. — Perhaps this and both the foregoing species are only forms of the Mexican *M. cornifera*, of De Candolle. Only a close examination of these plants in their native wilds will enable us to decide this point.

23. M. CALCARATA, E. in Pl. Lindh. 2, 1850 (M. sulcata, E. in Pl. Lindh. 1, 1845. M. strobiliformis, Muhlenpf.? non Scheer) : globosa, prolifera, cæspitosa ; tuberculis e basi dilatata ovatis conicis ; aculeis albidis, radialibus 8–10 rigidis subulatis rectis s. paullo recurvis, additis subinde ex summa areola aculeis adventitiis 3–5 fasciculatis tenuioribus, centrali singulo robustiore subulato recurvato, in plantis junioribus deficiente ; floribus magnis sulphureis intus basi rubicundis.

Texas, from the Brazos to the Nueces rivers : fl. May. — Larger heads 2–2½ inches in diameter; cæspitose masses a foot or more large ; tubercles spreading, or in older flowering plants often somewhat adpressed and imbricate, 7–9 lines long ; spines 4–8 lines long. Flower 2¼–2½ inches long, and of same diameter. Seeds a line long. [268]

§ 3. RUBRIFLORÆ.

* *Sepalis integerrimis.*

24. M. CONOIDEA, DC. (M. strobiliformis, E. in Wisl. Rep. non Scheer) : found only south of the Rio Grande.

* * *Sepalis fimbriatis.*

25. ? M. POTTSII, Scheer : cylindrica, subramosa ; tuberculis ovatis obtusis levissime sulcatis, axillis sublanuginosis ; aculeis radialibus numerosissimis gracilibus albis, centralibus 6–12 validioribus expansis basi nodulosis apice sphacelatis ; floribus magnis e viridi rubellis ; baccis roseis.

Texas, on the Rio Grande, below Laredo, and from there to Chihuahua. — I have not seen this plant ; the description is taken from Salm and Poselger.

26. M. TUBERCULOSA, E. in B. C. R. : ovata s. ovato-cylindrica, simplex s. ad basin parce prolifera ; tuberculis e basi rhomboidea ovatis abbreviatis obtusis profunde sulcatis demum suberosis persistentibus confertis, axillis villosissimis ; aculeis exterioribus 20–30 rigidis albidis, interioribus 5–9 robustioribus cæsio-purpureis sphacelatis, superioribus longioribus erectis, infimo breviore robusto porrecto s. deflexo ; floribus in vertice densissime tomentoso centralibus pollicaribus dilute roseis ; baccis elongato-ovatis rubris ; seminibus minimis scrobiculatis.

On the mountains near El Paso, and eastward : fl. May and June. Plant 2–5 inches high ; tubercles 2½–3 lines long, dry and hard, not fleshy unless very young, nor shrivelling when old, but losing the spines and covering the lower part of the plant like corky protuberances. Outer spines usually 2–4, rarely 5 or 6, lines long ; interior spines 4–9 lines long ; those of the upper tubercles forming a tuft of grayish-purple color on top of the plant. Flowers very pale purple, one inch in diameter. Berry red, three fourths of an inch long, one fourth of an inch thick, crowned with the remains of the flower. Seeds short, thick, about half a line long. — The short, corky tubercles, with very deep grooves, and very woolly when young, together with the long red fruit, distinguish our species from all the allied forms.

27. M. DASYACANTHA, E. in B. C. R. : simplex, subglobosa ; tuberculis teretibus laxis leviter sulcatis ; [269] axillis subvillosis; aculeis rectis tenuibus setaceis patulis, exterioribus 25–35 albidis, interioribus 7–13 longioribus purpureo-fuscis, centrali infero æquilongo; baccis centralibus ovatis ; seminibus obovato-globosis nigricantibus scrobiculatis.

El Paso and eastward. — Specimens before me are 1½–2½ inches high and a little less in diameter ; tubercles 4–5 lines long ; spines more slender and soft than in the allied species, often capillary, spreading, but not radiating, 6–12 lines long, only the lower exterior ones a little shorter. Seeds about half a line long. Very nearly allied to the next.

28. M. VIVAPARA, Haw.: simplex s. cæspitosa ; tuberculis teretibus laxis leviter sulcatis ; aculeis rectis rigidis, exterioribus patentissime radiantibus albidis 12–36, centralibus 3–12 robustioribus longioribus obscurioribus, singulo robustiore porrecto deflexove, ceteris sursum divergentibus ; floribus subcentralibus purpureis magnis ; baccis sublateralibus ovatis viridibus ; seminibus obovatis scrobiculatis fulvis.

Var. *α*. VERA : depresso-globosa, simplex s. plerumque prolifera, cæspitosa ; aculeis radialibus 14–20, centralibus 3–8.

Var.? *β*. RADIOSA : ovata s. subcylindrica, simplex s. e basi ramosa ; aculeis radialibus 12–36, centralibus 3–12.

Subvar. *a.* RADIOSA BOREALIS: subglobosa; aculeis radialibus albidis 12–20, centralibus 3–6 purpureo-maculatis; floribus minoribus. — *b.* RADIOSA NEO-MEXICANA: ovata; aculeis radialibus albidis 20–36, centralibus 3–12 supra purpurascentibus sphacelatis; floribus majoribus. — *c.* RADIOSA TEXANA: ovato-cylindrica; aculeis radialibus albidis 20–30, centralibus 4–5 flavis s. fulvis; floribus seminibusque magnis. *M. radiosa*, E. in Plant. Lindh. 2, 1850.

In the Western plains and on the Rocky Mountains: var. *a.* on the Upper Missouri and Yellowstone rivers; *β. a.* in northern New Mexico; *β. b.* from western Texas to New Mexico and Sonora; *β. c.* in Texas, west of New Braunfels. — The extreme forms are certainly very unlike one another, but the transitions are so gradual that I cannot draw strict limits between them. Even the proliferous growth of the original *M. vivipara* is not constant, and I have seen many simple specimens from the Upper Missouri. The simple ones seem to flower better than the proliferous ones, which are often sterile. — Plants from 1 to 5 inches high, 1½–2 inches in diameter; tubercles 4–6 lines long; spines always rigid, 3–10 lines long. Flowers different in size, 1½–2½ inches in diameter, beautifully purple, with numerous narrowly lanceolate acuminate petals. Seeds ½–1 line long.

29. M. MACROMERIS, E. in Wisliz. Rep. (M. dactylothele, Lab.): simplex s. e basi ramosa, ovata; [270] tuberculis magnis patulis, laxis, tenuiter ultra medium sulcatis; aculeis tenuibus elongatis rectis s. paullo curvatis exterioribus 10–17 albidis, centralibus sub-4 longioribus robustioribus subangulatis, fuscis s. nigricantibus; floribus ex areolis supra-axillaribus in tuberculo ipso oriundis magnis; bacca subglobosa viridi; seminibus parvis lævibus fuscis.

In the valley of the Rio Grande, from southern New Mexico to the middle course of the river near Presidio, and even lower down: flowers July and August. — A most remarkable species in many respects, and forming a transition to Echinocactus, though the mamillate form is so very striking. Plant 2–4 inches high; tubercles variable, 6–8 or 10–12 and even 15 lines long. Radial spines ½–1½ inches long; central ones often 1½–2¼ inches in length. Axils always naked. Flower springing from the lower end of the groove, which runs down about two thirds of the tubercle, 2½–3 inches in diameter, rose-colored or purple; not rarely with a few sepaloid scales on the ovary (and fruit). Seeds thick, but only 0.6–0.8 line long.

Subgen. 3. ANHALONIUM. (Gen. *Anhalonium*, Lem. *Ariocarpus*, Scheidw.) Flores e basi tuberculorum hornotinorum triangularium subinermium vel in vertice ipso oriundi: ovarium emersum.

30. M. FISSURATA, E. in B. C. R.: simplex, depresso-globosa s. applanata; tuberculis e basi applanata crassis extus infraque lævibus, supra sulco centrali villoso lateralibusque glabris profunde quadripartitis sulcisque transversalibus superficialiter multifidis, inermibus; floribus e villo longo sericeo centralibus roseis; baccis ovatis virescentibus in lana densa occultis; seminibus nigris tuberculatis.

On the limestone hills, near the junction of the Pecos with the Rio Grande: flowers October. Heads 2–4½ inches in diameter; tubercles 6–10 lines long and a little less broad; central longitudinal groove in the very young ones bearing dense silky wool over ½ inch long, which by age becomes dirty and matted, and finally disappears entirely in the very old ones. The lower end of the groove, which only extends down as far as the rough or verrucose part of the tubercle goes (about two thirds downward), bears the flower and fruit, very much like the floriferous areola of the last-mentioned species. Flower about 1 inch long and wide. Seed very roughly tuberculated, different from that of any other *Mamillaria* examined by me, but quite similar to that of other *Anhalonia*.

II. ECHINOCACTUS, Link. & Otto. [271]

Ovarium emersum baccaque sepalis stipata. Semina sæpe albuminosa. Cotyledones plus minus foliaceæ plerumque hamatæ. — Plantæ subglobosæ, costatæ; inflorescentia verticali.

§ 1. HAMATI, Salm.

1. E. SCHEERII, Salm: globosus s. ovatus; costis 13 obtusis interruptis; tuberculis supra ad medium sulcatis; aculeis radialibus 15–18 setaceis, centralibus 3–4 angulatis variegatis, superioribus rectis longioribus sursum divaricatis, inferiore robustiore breviore hamato; floribus minoribus flavo-virescentibus; bacca virescente; seminibus fuscis.

About Eagle Pass, on the Rio Grande: flowers August to October. — A most elegant little species, 1½–2 inches high; larger spines black and white variegated; radial ones 3–6, central ones 6–12 lines long; floriferous areola united by a groove of 1–2½ lines in length with the spines, resembling the groove of the *Coryphanthæ*, especially of *Mamillaria macromeris*. Green flower 1 inch long, much less in diameter.

2. E. BREVI-HAMATUS, E. in B. C. R.: obovato-globosus; costis 13 compressis obtusis interruptis; tuberculis supra usque ad basin sulcatis; aculeis radialibus 12 teretibus albidis, centralibus 4 complanatis, lateralibus rectis sursum versis paullo longioribus, summo debiliore et infimo robustiore deorsum hamato brevioribus; floribus minoribus roseis.

On the San Pedro, and about Eagle Pass: flowers April. — Very similar to the last, but larger, 3–4 inches high, with fewer spines, the lower central usually hardly longer than the upper radial ones, about 1 inch long; lower radial spines shorter, and upper central ones longer. The rose-colored flowers are 12–16 lines long, much less wide. Fruit unknown.

3. E. WHIPPLEI, E. & B. in Pacific R. R. Rep.: ovato-globosus; costis 13–15 interruptis; aculeis radialibus 7 compressis albidis, centralibus 4 longioribus robustioribus compresso-quadrangulatis, summo latiore longiore, infimo robustiore deorsum hamato; seminibus magnis nigris.

On the Colorado-Chiquito, in western New Mexico. — Plant 3–5 inches high; exterior spines 6–9 lines, upper central spine 12–18 lines long, and ½–1¼ lines broad; other central spines a little shorter. Seed very [272] large, over 1½ lines in the longest diameter. — Principally characterized by the few radial spines and the very broad upper central one, which with the former forms an almost regular circle.

4. E. POLYANCISTRUS, E. & B. l. c.: ovatus, s. ovato-cylindricus; costis 13–17 interruptis; aculeis radialibus sub-19 complanatis albis, superioribus latioribus longioribus, inferioribus setaceis, centralibus difformibus, summo complanato elongato sursum curvato albo, reliquis 5–10 teretiusculis purpureo-fuscis, superioribus 2 rectis, ceteris uncinatis.

Eastern slope of the California mountains, at the head of the Mojave River. — Plant 4–10 inches high, 3–4 in diameter; radial spines ½–2 inches long; upper central spine 3–5, the others 1½–3½ inches long, the lowest shorter than the others. The number of the hooked spines varies from 3 to 7, according to age and development.

5. E. UNCINATUS, Hopf., var.? WRIGHTII, E. in B. C. R.: glaucescens, ovatus; costis 13 interruptis; tuberculis usque ad basin sulcatis; aculeis radialibus 8, inferioribus 3 uncinatis fuscis, reliquis 5 rectis, centrali singulo angulato complanato flexuoso hamato elongato erecto stramineo apice fusco; floribus fusco-purpureis minoribus.

Near El Paso and on the Rio Grande below: flowers March and April. — Plant 3–6 inches high, 2–3½ inches in diameter; the tuft of long, erect, straw-colored spines is very characteristic. Lower hooked radial spines about 1 inch long; upper ones a little longer; central spine 2–4 inches long. Flowers 1–1½ inches long. Berry fleshy, scaly. Seeds much compressed. — The Mexican *E. uncinatus* has 7–8 radial spines, similarly arranged, and 4 central spines; the three upper ones not much longer than the upper radial ones and straight, the lower one elongated and hooked. The flower and seed differ also to some extent.

6. E. SETISPINUS, E. in Plant. Lindh. 1845: globosus, ovatus s. subcylindricus; costis 13 compressis acutatis angulatis; tuberculis brevissime sulcatis; aculeis radialibus 10–16 setaceis; centrali subsingulo robustiore terete fusco uncinato s. flexuoso curvato; floribus magnis flavis intus coccineis; bacca pisiformi coccinea; seminibus tuberculatis.

Var. *α*. HAMATUS: aculeis radialibus sub-12, centrali hamato robusto. — *E. hamatus*, Muhlenpf. *E. Muhlenpfordtii*, Fen.

Var. *β*. SETACEUS: minor; aculeis pluribus, centralibus 1–3 tenuioribus vix hamatis.

Texas, from the Colorado to the Rio Grande, and westward as far as the San Pedro River: flowers April [273] to October. — It is unnecessary further to describe this well-known and well-characterized species, which is now frequently cultivated; the compressed ribs, setaceous spines, small red berry, and tuberculated seeds easily distinguish it from all its allies.

7. E. SINUATUS, Dietr. (1851): globosus; costis 13 compressis acutiusculis interruptis; aculeis radialibus setaceis, 3 superioribus et 3 inferioribus rectiusculis fuscatis, lateralibus 2–6 tenuioribus albidis flexuosis, rarissime hamatis; centralibus 4 robustioribus, 3 superioribus rectis purpureo-variegatis, inferiore compresso seu canaliculato elongato flexuoso vel hamato stramineo; floribus magnis flavis; bacca ovata viridi; seminibus minutissime punctatis.

Country along the Rio Grande near Eagle Pass, and from there eastward. — Intermediate between the foregoing and the next species, and considered by Dr. Poselger a connecting link between them; but easily distinguished from the former by the larger size, thicker ribs, flattened central spine, and by the shining, finely dotted seeds; from the latter, to which it approaches much more closely, by the more compressed and less strongly tuberculated ribs, the smaller number of stigmata (8–12), smaller fruit, and much more finely dotted seed. — Poselger considers this a variety of *E. setispinus*. His *E. setispinus*, var. *robustus*, has the same seeds, and no doubt also belongs here; it is said to have all the four central spines, and some of the radial ones, hooked. *E. Treculianus*, Lab. belongs here, or perhaps to the next.

8. E. LONGEHAMATUS, Gal.: subglobosus; costis 13–17 obtusis tuberculato-interruptis; tuberculis breviter sulcatis; aculeis radialibus rigidis subteretibus, infimis summisque ternis, lateralibus 2–6 longioribus; centralibus 4 robustis angulatis annulatis, quorum infimus deorsum hamatus rectus seu flexuosus, additis subinde 2–4 superioribus

cum radialibus superioribus fasciculatis; floribus magnis flavis; stigmatibus 15–18; bacca oblonga virescente squamosa; seminibus lucidis exsculptis.

Var. *α.* CRASSISPINUS: aculeis robustissimis radialibus 8–11, centralibus 4 angulatis, infimo flexuoso plus minus hamato. *E. flexispinus*, E. in Wisliz. Rep. *non* Salm.

Var. *β.* GRACILISPINUS: aculeis gracilioribus 16–20, exterioribus 12–14, centralibus 4–8, infimo elongato hamato. *E. hamatocanthus*, Muhl.

Var. *γ.* BREVISPINUS: aculeis gracilioribus radialibus 8–11, centralibus 4 teretibus cum infimo hamato [274] radiales vix superantibus.

East of El Paso, near the Pecos and San Pedro Rivers, and along the middle course of the Rio Grande: var. *α.* south of the Rio Grande. Flowers July and August. — Plants from ½–2 feet high; the larger ones ovate; areolæ distant. Spines very different in size in the different varieties; radial spines 1–3½, central spines 1½–6½ inches long. Flowers 2½–3½ inches long. Seeds similar to the last, but with much larger pits.

§ 2. CORNIGERI.

A. *Heteracanthi.*

9. E. WISLIZENI, E. in Wisliz. Rep.: giganteus, globoso-ovatus; costis 21 compressis crenatis; areolis elongatis; aculeis radialibus summis infimisque 6 robustis rectis seu curvatis, lateralibus 14–20 (additis subinde summis brevioribus fasciculatis) tenuibus elongatis flexuosis; centralibus 4 robustis angulatis annulatis rubellis, 3 superioribus rectis, inferiore canaliculato deorsum hamato; floribus flavis; bacca ovata squamosissima; seminibus reticulatis.

Valley of the Rio Grande about El Paso, and thence to the Upper Gila: flowers July and August. — Plant 2–4 feet high; diameter smaller. Radial spines 1–2, central ones 1½–3 inches long. Flowers 2½ inches long.

10. E. LECONTEI, E. in P. R. R.: giganteus, obovato-claviformis; costis 20–30 compressis crenatis; areolis elongatis; aculeis radialibus summis infimisque 6–10 robustis angulatis plus minus curvatis, lateralibus 10–16 (addidis subinde summis brevioribus fasciculatis) tenuibus elongatis flexuosis, centralibus 4 robustis compressis annulatis corneis, 3 superioribus sursum inferiore subinde subhamato deorsum curvatis; floribus flavis; bacca ovata squamosa; seminibus scrobiculatis.

On the lower parts of the Gila and Colorado Rivers, and in Sonora: flowers August and September. Very similar to the last, but a more slender, often quite clavate plant; larger specimens 3–4 feet high, and of only one third that diameter. Arrangement of spines similar, but generally 5 (not 3) radial spines below the lowest central one; central spines more compressed, upper ones curved, lower one rarely somewhat hooked. Flower, fruit, and seed smaller; seed more oblong and pitted.

E. INGENS, Zucc., in the number and arrangement of spines, is the simple type of our more northern [275] species. It has on the oval areolæ 4 stout cruciate central spines, 3 upper and 3 lower radial ones, and only 2 slender lateral spines. Seeds smooth. The flower seems to refer it, however, to the *Eriocarpi*.

B. *Homœacanthi.*

***Lepidocarpi.*

11. E. EMORYI, E., in Emory's Rep. 1848, and B. C. R.: grandis, ovatus; costis 13–20 obtusis tuberculatis; areolis ovatis; aculeis radialibus 7–8 subæqualibus robustis subangulatis annulatis paullo recurvatis rubellis 1–2 polli-caribus, centrali singulo recurvo s. subhamato paullo robustiore; floribus magnis purpurascentibus.

Lower Colorado, and principally in Sonora: flowers August and September. Larger plants 2½–3 feet high; spines usually 1–2, and in a large specimen from Guaymas nearly 3 inches long. Flowers about 3 inches long. Fruit unknown.

12. E. VIRIDESCENS, Nutt.: globosus, simplex seu raro ramosus; costis 13–21; aculeis robustis compressis annulatis plus minus curvatis rubellis, radialibus 12–20 infimo breviore magis curvato; centralibus 4 angulatis robustioribus longioribus, infimo rectiore longiore; floribus virescentibus; bacca squamosa; seminibus minutissime scrobiculatis.

San Diego, California. — Less than a foot in diameter, globose or flattened. Radial spines 5–10 lines long, 3 upper central ones a little longer, and lower central spine 12–18 lines long. Flower 1½ inches long.

13. E. CYLINDRACEUS, E. in Sill. Journ. 1852: ovatus seu subcylindricus, plerumque e basi ramosus; costis 21 vel pluribus; aculeis robustis compressis annulatis plus minus curvatis flexuosisve rubellis, radialibus sub-12, aculeis adventitiis sub-5 gracilioribus supra sæpe adjectis, infimo hamato, centralibus 4 angulatis robustissimis cruciatis, superiore latiore sursum recto, inferiore decurvato; floribus flavis; bacca squamosa.

San Felipe, on the eastern slope of the California mountains: flowers in June. — The largest specimens seen were 3 feet high and 1 foot in diameter; the branches or young single plants are globose. Radial spines 1–2 inches long; central spines 1–1½ lines broad, about 2 inches long. Similar to the last, but well distinguished by the characters indicated.

* * *Eriocarpi.* [276]

14. E. POLYCEPHALUS, E. & B. in P. R. R.: ovatus seu demum cylindricus, e basi ramosus; costis 13–21 acutis; aculeis robustis compressis annulatis plus minus curvatis rubellis, radialibus 4–8, infimo deficiente, superioribus (si exstant) gracilioribus; centralibus 4 angulatis compressis, superiore latiore suberecto vel sursum curvato, inferiore longiore decurvo; floribus flavis dense lanatis; bacca sicca; seminibus magnis angulatis.

On the Mojave, Colorado, and Gila rivers: flowers February and March. — Single only when young, forming bunches of 20–30 cylindric equal-sized heads when older; the largest seen were 2–2½ feet high and about 10 inches in diameter. Exterior spines 1–2, interior ones 1½–3½ inches long. — Shape very much like the last, but the flower very distinct.

15. E. PARRYI, E. in B. C. R.: simplex, globosus vel depressus; costis 13 acutis; aculeis robustis angulatis annulatis albidis, radialibus 8–11, rectis s. paullo curvatis superioribus gracilioribus, infimo deficiente, centralibus 4 paullo longioribus robustioribus, infimo longiore decurvo; bacca sicca dense lanata.

West and southwest from El Paso. — Plant always single; largest specimens 8–12 inches high by 10–15 in diameter. — Very similar to the last, but apparently distinct by the manner of growth and the white spines. Unfortunately, no seeds were collected.

16. E. HORIZONTHALONIUS, Lem., var. CENTRISPINUS, E. in B. C. R.: glaucus, depressus seu demum ovatus; costis 8 obtusissimis latissimis; areolis orbiculatis basi truncatis; aculeis robustis compressis annulatis recurvatis rubellis demum cinereis, radialibus 5–7 superioribus debilioribus, infimo deficiente, centrali singulo robustiore decurvato; floribus purpureis dense lanatis; bacca sicca lanata; seminibus magnis angulatis.

From Doñana, above El Paso, to the Pecos, and southward: flowers April and May. — Plant 2–8 inches high and 3–6 in diameter. Spines ¾–1½ inches long, nearly equal. Flower 2½ inches long, but partly enveloped in dense wool. The original *E. horizonthalonius* is said to have no central spine, and linear-lanceolate acuminate pale rose-colored petals: in our plant the petals are oblong-lanceolate and obtuse.

17. E. TEXENSIS, Hopf., *E. Lindheimeri*, E. in Plant. Lindh. 1845: depressus; costis 13–27 acutis [277] undulatis; areolis cordatis; aculeis robustis annulatis, plus minus curvatis rubellis, radialibus 6–7 infimo deficiente, centrali singulo robustiore compresso decurvato; floribus roseis dense lanatis; petalis laciniatis aristatis; bacca coccinea lanata; seminibus lævibus lucidis.

Southern Texas and northeastern Mexico, from the Colorado to Saltillo; not westward beyond the San Pedro River: flowers April and May. — Heads 8–12 inches in diameter, flat, or very old ones sometimes globose; spines from ½–2 inches long. Flowers about 2 inches long.

§ 3. THELOIDEI, Salm.

18. E. BICOLOR, Gal., var. SCHOTTII, E. in B. C. R.: ovatus; costis 8 obtusis interruptis; aculeis radialibus 15–17 rectis, summis 2–4 longioribus latioribus compressis, centralibus 4, summo latiore longiore; floribus majoribus purpureis.

Mier, on the Rio Grande: flowers September. — Plant 4–6 inches high, 2–3 in diameter. Upper radial spines about 1 inch, upper central one 1½ inches long; lower radial and central spines reddish variegated. Flower 2–3 inches long, bright purple or rose-colored. — Distinguished from the Mexican *E. bicolor* principally by the larger number of radial spines, and the greater length of the upper central spine, which is carinate underneath.

§ 4. INTERTEXTI.

19. E. INTERTEXTUS, E. in B. C. R.: minor, ovato-globosus; costis 13 acutis interruptis; tuberculis sulcatis; aculeis rigidis rubellis apice fuscatis, radialibus 16–25 arcte adpressis, superioribus 5–9 tenuioribus subfasciculatis, infimo robusto brevi; centralibus 4, superioribus 3 radiales superiores excedentibus cum iis implicatis, inferiore singulo abbreviato porrecto; floribus parvis in vertice dense lanato congestis roseis; bacca vix squamata sicca; seminibus lucidis scaphoideis.

Var. β. DASYACANTHUS, E. l. c.: ovatus; aculeis setaceis longioribus purpureo-cæsiis, radialibus patulis, centrali inferiore ceteris paullo breviore.

From El Paso to the Limpio, and southward to Chihuahua: var. β. more common about El Paso: flowers March and April. — Plant 1–4, the var. β. even 6 inches high, 1–3 in diameter. Spines 2–6, central ones 1–9 lines long; in β. 6–8, and central spines 9–11 lines long. Flower about 1 inch long. Fruit 4 lines in diameter.

E. UNGUISPINUS, E. in Wisliz. Rep., from the country between Chihuahua and Parras, belongs here. The fruit described as belonging to this species is that of *E. uncinatus*. [278]

Subtrib. 2. CONTRARIÆ. Cotyledones facie hilum versus spectantes, lateribus seminis contrariæ.

III. CEREUS, Haw.

Ovarium baccaque sepalis squamiformibus in axillis plerumque pulvilligeris stipatæ. Stamina tubo floris breviori seu elongato infundibuliformi gradatim adnata. Semina fere exalbuminosa. Cotyledones abbreviatæ seu foliaceæ, plerumque hamatæ. — Plantæ costatæ, inflorescentia laterali.

Subgen. 1. ECHINOCEREUS, E. in Wisliz. Rep.: ovarium aculeolatum: tubus floris abbreviatus, subcampanulatus: stigmata crassa viridia: semina tuberculosa: cotyledones suberectæ. — Plantæ humiles, sæpe subglobosæ, e basi ramosæ vel ramosissimæ.

§ 1. PECTINATI, multicostati; areolis confertissimis plerumque elongatis, aculeis rigidis brevibus pectinatis.

* *Viridiflori.*

1. C. VIRIDIFLORUS, E. in Wisliz. Rep.: ovatus seu demum cylindricus, simplex vel parce ramosus; costis sub-13; areolis ovato-lanceolatis; aculeis arcte radiantibus 12–18 cum superioribus 2–6 setaceis, lateralibus cæteris longioribus, inferioribus plerumque purpureo-fuscis, cæteris albidis, centrali plerumque nullo, subinde singulo robustiore variegato; floribus versus apicem lateralibus e flavo virescentibus minoribus; baccis ellipticis parvis; seminibus tuberculatis.

Var. *α.* MINOR: subglobosus; aculeis gracilibus brevibus.

Var. *β.* CYLINDRICUS: major, elongatus; aculeis rigidioribus longioribus.

Throughout western Texas and New Mexico. Var. *α.* about Santa Fé and northeastward: *β.* east of El Paso. Flowers May and June. — The small form is 1–2 inches high, with spines rarely more than 2 lines long; the larger form *β.* is 3–6 or more inches high, its spines 2–5 or 6 lines long; central spines, when present, longer and stouter. Flower about 1 inch long.

2. C. CHLORANTHUS, E. in B. C. R.: cylindricus, simplex, seu parce ramosus; costis 13–18; areolis ovatis; aculeis laxe radiantibus 12–20 cum superioribus 5–10 setaceis plerumque albidis; centralium 3–5 superioribus 2 brevioribus purpurascentibus, inferioribus 1–3 longioribus deflexis albidis; floribus in caule inferiore lateralibus e flavo virescentibus minoribus; baccis parvis; seminibus tuberculato-scrobiculatis. [279]

Common about El Paso: flowers April. — Stems 3–10 inches high, 1½–2 inches in diameter; radial spines 2–5, central ones 9–15 lines long. Flowers very similar to those of the last species, but seeds different.

* * *Flaviflori.*

3. C. DASYACANTHUS, E. in Wisliz. Rep.: subcylindricus, simplex vel e basi ramosus; costis 16–21; areolis ovatis; aculeis 20–30 patulis cinereis apice sæpe rubellis, interioribus 3–8 paullo robustioribus deflexis; floribus subterminalibus magnis; bacca subglobosa; seminibus tuberculatis.

Var. *β.* MINOR: aculeis paucioribus; bacca minore.

Common about El Paso: flowers April. — Plant 5–12 inches high, densely covered with numberless spines. Flowers 3 inches wide, yellow, — an uncommon color in *Cerei*. Fruit an inch in diameter; in var. *β.* only half as large.

4. C. CTENOIDES, E. in B. C. R.: subsimplex, ovatus, 15-costatus; areolis lanceolatis; aculeis albidis, radialibus 14–20 pectinatis, centralibus 2–3 uniseriatis brevibus; floribus magnis.

Eagle Pass on the Rio Grande: flowers June. — Plant 2–4 inches high, thick in proportion; spines 1–4 lines long. Flower large. — Similar to the last, but distinguished by the characters given, which, with the exception of the yellow flower, bring it close to *C. pectinatus*.

* * * *Rubriflori.*

5. C. PECTINATUS, E., *Echinocactus pectinatus*, Scheid.: ovato-cylindricus, 18–23-costatus; areolis lanceolatis; aculeis radialibus 16–20 subrecurvis pectinatis apice roseis, centralibus 2–5 brevissimis uniseriatis; tubo floris purpurei pulvillis 60–70 aculeolos rigidos 10–15 gerentibus stipato.

Var. *β.*? ARMATUS, Poselg.: costis 15–16; aculeis radialibus 16–20, centrali singulo cæteris longiore.

Var. *γ.*? RIGIDISSIMUS, E. in B. C. R.: costis 20–22; aculeis e basi bulbosa subulatis rigidissimis albidis seu rubellis 15–22 centralibus nullis; florum subverticalium tubo pulvillis 80–100 dense stipato.

South of the Rio Grande, Chihuahua, etc. — The var. *β.* from Monterey may belong either here or to the next species. The var. *γ.* from Sonora, without any central spines, and with very rigid radial ones, 1–4½ lines long, is not yet sufficiently known to decide about its affinities. [280]

6. C. CÆSPITOSUS, E. in Plant. Lindh. 1845 : ovato-cylindricus, 12–18-costatus; areolis lanceolatis ; aculeis radialibus 20–30 rectis seu subrecurvis pectinatis albidis, centrali nullo vel raro, uno alterove brevissimo ; tubo floris purpurei pulvillis 80–100 aculeolos capillares 6–12 obscuros lanamque longam cineream gerentibus dense stipato.

Var. *α.* MINOR : aculeis brevioribus gracilioribus non intertextis; floribus minoribus.

Var. *β.* MAJOR : aculeis longioribus robustioribus intertextis ; floribus majoribus.

Var. *γ.* CASTANEUS : aculeis rubellis seu castaneis.

From the Canadian near Delaware Mount, to the Rio Grande, and south to Monterey ; west not farther than the San Pedro River : flowers in May and June. — This species, now not rare in cultivation, seems to be sufficiently distinct from the preceding, and may always be recognized by the characters indicated.

7.? C. ADUSTUS, E. in Wisliz. Rep.: ovatus, 13–15-costatus; areolis ovatis seu ovato-lanceolatis; aculeis radialibus 16–20 adpressis albidis apice adustis, lateralibus inferioribusque longioribus, summis setaceis brevissimis, centrali nullo seu valido porrecto atrofusco.

Mountains west of Chihuahua : flower and fruit unknown. — *Echinocereus radians*, E., is the form with stout central spines.

8.? C. RUFISPINUS, E. l. c. : ovato-cylindricus, 11-costatus ; areolis lanceolatis ; aculeis radialibus 16–18 adpressis intertextis, lateralibus cæteris multo longioribus fuscis recurvatis, centrali singulo valido fusco porrecto ; flore infundibuliformi, tubo subelongato, limbo patulo ; stigmatibus 8 tenuibus albidis.

Mountains west of Chihuahua: flowers in May. — Stem 4 inches high ; radial spines 4–9 lines, central one about an inch long. Flower different from that of all other *Echinocerei* in the length of the tube (over 2 inches long and half as wide) and the whitish stigmata. Seems to form a transition to other sections of the genus.

9.? C. LONGISETUS, E. in B. C. R. : subsimplex, ovato-cylindricus; costis 11–14 tuberculatis ; areolis orbiculatis ; aculeis setaceis albis, radialibus 18–20, centralibus 5–7, quorum 3 inferiores elongati deflexi. [281]

Santa Rosa, south of the Rio Grande. — Stem 6–9 inches high ; tubercles well marked ; lower radial spines 5–7 lines long, much longer than the upper ones ; lower central spines 1–2 inches long. Flower said to be red.

§ 2. DECALOPHI.

* *Purpurei ; floribus diurnis.*

10. C. FENDLERI, E. in Pl. Fendl. : ovato-cylindricus ; costis 9–12 ; areolis subconfertis ; aculeis basi bulbosis, radialibus 7–10 rectis seu curvatis albidis et fuscis, inferioribus robustioribus, centrali valido sursum curvato atrofusco plerumque elongato ; floribus sub vertice lateralibus magnis ; seminibus obliquis tuberculato-scrobiculatis.

New Mexico, from Santa Fé to below El Paso, and from east of the Pecos to Zuni : flowers in May and June. — Stems 3–8 inches high, not many from the same base ; spines very variable, but always very bulbous at the base, and some of them white, some deep brown or black, and others party-colored ; radial ones $\frac{1}{2}$–1 inch, and the central one 1–2 inches long. Flower $2\frac{1}{2}$–$3\frac{1}{2}$ inches in diameter, of a deep purple color. Berry 1–$1\frac{1}{4}$ inch long, edible. Seed deeply and irregularly pitted by the confluence of many of the tubercles, unusually oblique.

11.? C. MOJAVENSIS, E. & B. in P. R. R. : ovatus, dense cæspitosus, glaucescens, 10–12-costatus ; areolis remotis ; aculeis validis curvatis, radialibus 7–8, lateralibus robustioribus longioribus, centrali singulo sursum curvato elongato.

Var. *β.*? ZUNIENSIS : 10-costatus ; aculeis debilioribus 4-angulatis bulbosis rectis vel flexuosis, radialibus 8, summo longiore robustiore ; centrali recto seu sursum curvato longiore, omnibus bulbosis.

On the Mojave River in California, and *β.* farther east, on the Colorado Chiquito. Ovate heads 2–3 inches high, forming dense cæspitose masses ; upper and lower spines 9–15 lines, lateral ones 15–25 lines long, central spine $1\frac{1}{2}$–$2\frac{1}{2}$ inches long, dusky. Var. *β.* is distinguished by having the upper radial spine almost as stout and long as the central spine, the former being 12–18, the latter 18–24 lines long. Both seem to be distinguished from the nearly allied *C. Fendleri* by having the lowest spines weakest, while in that species they are the stoutest of the exterior ones. The resemblance to *C. Fendleri* induces me to place this species here, though the flower remains unknown. [282]

12. C. ENNEACANTHUS, E. in Wisliz. Rep.: ovato-cylindricus, viridis, cæspitosus, 7–10-costatis; aculeis rectis, radialibus 7–12 (plerumque sub-8) albis, inferioribus longioribus ; centrali singulo (rarius 2–3) basi bulboso teretiusculo seu compresso angulato albido vel stramineo ; ovario pulvillis 25–35 aculeolos 6–12 gerentibus stipato ; seminibus tuberculatis.

In the Rio Grande valley from El Paso to Laredo, and lower down, and far into Mexico : flowers April and May. — A very cæspitose plant, of a wrinkled or withered appearance ; 3–6 inches high ; spines above 3–5, below 8–16 lines long ; lateral ones intermediate; central spine extremely variable, in smaller specimens terete, in very perfect ones elongated, flattened, 8 or 10–15 or 20 lines long. Flowers 2–3 inches long and equally wide : ovary and tube covered with numerous bunches of spines. Fruit about an inch long, edible.

13. C. STRAMINEUS, E. in B. C. R.: ovato-cylindricus, cæspitoso-conglomeratus, 11–13-costatus, læte viridis; aculeis radialibus 7–10 rectis vel curvatis albis subæqualibus, centralibus 3–4 angulatis elongatis sæpe flexuosis; floribus magnis purpureis; ovario pulvillis 30–40 aculeolos subsingulos gerentibus stipato; bacca magna fasciculis aculeolorum elongatorum stipata; seminibus tuberculatis.

Mountain slopes, from El Paso to the Pecos and Gila Rivers: flowers June. Often from 100 to 200 heads in one hemispherical mass, each 5–9 inches high; radial spines mostly 8, ¾–1¼, central ones 2–3½ inches long, younger ones dirty yellow and brown, like old straw. Flower 3–4 inches long, very full, bright purple. Berry 1½–2 inches long, luscious.

14. C. DUBIUS, E. in B. C. R.: ovato-cylindricus, cæspitosus, pallide viridis, 7–9-costatus; aculeis radialibus 5–8 albidis, superioribus sæpe nullis, centralibus 1–4 angulatis plus minus elongatis sæpe curvatis; floribus pallide purpureis; ovario pulvillis sub-20 aculeolos 1–2 gerentibus stipato; bacca minore aculeolata; seminibus tuberculato-scrobiculatis.

Sandy bottoms of the Rio Grande at El Paso: flowers May and June. Stems 5–8 inches high, somewhat cæspitose, of a pale green color, and a soft flabby texture: ribs broad, fewer; radial spines 6–12 or 15 lines long; central spines 1½–3 inches long, flowers 2½ inches long, with fewer and narrower petals. Fruit 1–1½ inches long, covered with bunches of spines which, as in the last species, on the flower are indicated only by few and short [283] bristles. Seed with tubercles confluent, and leaving pits between them. Nearly allied to the two last, but sufficiently well distinguished by the characters given.

15. C. ENGELMANNI, Parry in Sill. Journ. 1852: ovato-cylindricus, 11–13-costatus; aculeis radialibus sub-13 albidis, superioribus cæteris multo brevioribus, centralibus 4 longioribus angulatis rectis, 3 superioribus fulvis arrectis, inferiore longiore albido porrecto seu deflexo; floribus lateralibus; seminibus tuberculato-scrobiculatis.

Var. β. CHRYSOCENTRUS, E. & B. in P. R. R.: aculeis radialibus 12–14 albidis, centralibus 3 superioribus validis vitellinis erectis, inferiore albo compresso deflexo.

VAR. γ. VARIEGATUS, E. & B. l. c.: aculeis radialibus sub-13 albidis, centralibus 3 superioribus recurvatis divaricatis nigris corneo-variegatis, inferiore longiore albo decurvo.

Lower Gila, Colorado, and westward to the California mountains: flowers June and July. — Stems 5–10 inches high; radial spines slender, 3–6 lines, central ones 1–2 inches long. Fruit near the top of the plant. — Dr. Bigelow collected a little farther north, on Bill Williams's Fork, the two forms which I have put under β. and γ., though they differ from the species by having the fruit lower down on the plant; the arrangement of the spines, however, is entirely identical. Var. β. has very stout central spines, 2–3 inches long, of a deep golden-yellow color, and the lower one shorter. In var. γ. the central spines are only 1–2 inches long, much curved, and the upper ones white and black mottled.

* * *Coccinei; floribus diu noctuque apertis.*

16. ? C. GONACANTHUS, E. & B. in P. R. R.: ovatus, subsimplex, 7-costatus; areolis remotis; aculeis robustis angulatis sæpe curvatis, radialibus 8 flavidis sæpe basi obscuris, summo cæteris multo majore centralem multangulatum validum sæpe flexuosum subæquante.

Near Zuni, in western New Mexico, under cedars. — Radial spines 8–15 lines long, upper one and central spine 1¼-2½ inches long, remarkably stout, angular and channelled. — I have not seen the flower of this plant, but place it here from its resemblance to the next species; on the other hand, it seems to be allied to *C. Mojavensis*.

17. C. TRIGLOCHIDIATUS, E. in Wisliz. Rep.: ovato-cylindricus, 6–7-costatus, parce ramosus; areolis remotis; aculeis 3–6 robustis angulatis compressis rectis seu curvatis laxe radiantibus; floris coccinei staminibus [284] petala obtusa subæquantibus; stigmatibus 8–10.

Northern New Mexico, at Santa Fé, and to the east and westward: flowers June. — Stems 4–6 inches high, 2–3 in diameter, with sharp ridges and very shallow grooves; spines 6–15 lines long. Flower 2–3 inches long; petals rigid. Fruit unknown.

18. C. PHŒNICEUS, E. in P. R. R., *C. coccineus*, E. in Wisliz. Rep. non Salm.: ovatus seu subglobosus, obtusus, cæspitosus, 9–11-costatus; areolis ovato-orbiculatis subconfertis; aculeis setaceis rectis, radialibus 8–12 albidis, superioribus cæteris paullo brevioribus, centralibus 1–3 basi bulbosis teretibus paullo robustioribus; staminibus petalis brevioribus; stigmatibus 6–8.

Northern New Mexico, from the upper Pecos to Santa Fé, Zuni, and the San Francisco mountains: flowers May and June. — Heads 2–3 inches high, 2 inches thick, generally forming dense hemispherical masses, often of a foot or more in diameter; radial spines 3–6, central ones 5–10 lines long. When there are several, the lowest one longest. Fruit unknown.

C. CONOIDEUS, E. & B. l. c.: ovatus, versus apicem acutatus, conoideus, e basi parce ramosus 9–11-costatus; aculeis radialibus 10–12 gracilibus rigidis, summis brevioribus, centralium 3–5 infimo 4-angulato elongato demum deflexo.

Rocky places on the Upper Pecos, and perhaps San Francisco mountains. — Heads 3–4 inches high, few, of unequal height from one base; upper radial spines 2–5 lines, lateral ones 6–15 lines long; upper central spines hardly longer than the lateral ones; lower one 1–3 inches long, angular and often compressed. The Mexican *C. acifer*, Otto, seems similar, but is a higher plant, with much stouter spines. *C. Rœmeri*, Muhlenpf. A. G. Z. 1848, from Western Texas, may belong here or to *C. enneacanthus*. A specimen among Dr. Bigelow's collections seems to unite this form with *C. phœniceus*, where for the present it is perhaps best to leave our plant as a variety or sub-species.

19. C. POLYACANTHUS, E. in Wisl. Rep.: ovato-cylindricus, cæspitosus, subglaucescens, 9–13-costatus; aculeis robustis rigidis rectis albidis seu rubello-cinereis, centralibus 3–4 bulbosio paullo robustioribus æquilongis seu longioribus, junioribus sæpe fusco-variegatis; stigmatibus 8.

Common about El Paso, and thence to the mountains of Chihuahua: flowers March and April. — Heads [285] 5–10 inches high, $2\frac{1}{2}$–4 in diameter; upper radial spines $\frac{1}{2}$, lateral and lower ones $\frac{3}{4}$–1 inch long; central spines hardly longer, or the lower sometimes $1\frac{1}{2}$–$2\frac{1}{2}$ inches long. Flowers 2–3 inches long, profusely covering the plant for four or six weeks. Seed the largest of any *Echinocerei* known to me, 0.8–0.9 of a line long.

20. C. RŒMERI, E. in Pl. Lindh. 1850: ovatus, cæspitosus, læte viridis; costis 7–9 tuberculatis interruptis; areolis orbiculatis, junioribus breviter tomentosis; aculeis teretibus robustis albidis seu junioribus flavidulis demum cinereis, radialibus sub-8, centrali singulo robustiore porrecto; floribus lateralibus infundibuliformibus limbo erectiusculo; pulvillis ovarii tubique 16–18 albo-tomentosis aculeolos 3–5 gerentibus; sepalis interioribus 7–8 ovato-oblongis carinatis obtusis mucronatis; petalis 9–12 obovato-spathulatis obtusis integris concavis rigidis suberectis; stylo longe supra stamina albida sursum rosea exserto; stigmatibus 6–7 petala æquantibus erecto-patulis viridibus acutiusculis.

In the granitic region about the Llano River, western Texas: flowers May: fruit unknown. — Often 5–12 from the same base, densely cæspitose; single heads 3–4 inches high, 2–$2\frac{1}{2}$ in diameter; areolæ 6–8 lines apart; radial spines 5–12 lines long, upper ones usually a little shorter than the rest; central spine 10–15 lines long. Flower 2 inches long and only one in diameter, remaining open day and night for a whole week, if the weather is not too warm. — Allied to the last species; but distinct by the shorter heads, fewer ribs, fewer and paler spines, and smaller flower, with less numerous parts.

21. ? C. PAUCISPINUS, E. in B. C. R.: ovato-cylindricus, parce ramosus vel simplex, 5–7-costatus; areolis remotis; aculeis robustis 3–6 radiantibus fuscatis, centrali nullo vel raro robusto subangulato.

Western Texas, from the San Pedro to the mouth of the Pecos. — Stem 5–9 inches high, 2–3 in diameter; spines 9–16 lines long, dark-colored, the central one almost always wanting. Flower and fruit unknown.

22. ? C. HEXÆDRUS, E. & B. in P. R. R.: ovatus subsimplex, 6-costatus; areolis remotis; aculeis rectis rigidis tenuibus angulatis, radialibus 5–7 flavo-rubellis, inferiore breviore, centrali paullo robustiore (juniore fuscato) sæpe deficiente.

Near Zuni, in Western New Mexico. — Heads few in each plant, or single, 4–6 inches high, 2–$2\frac{1}{2}$ inches in diameter. Radial spines mostly 6 lines, lower ones 6–10 lines, upper ones 8–15 lines long; central spine, if [286] present, 12–15 lines long.

§ 3. PENTALOPHI.

23. C. BERLANDIERI, E. in B. C. R.: humilis, perviridis; caule diffuso subtereti articulato ramosissimo; tuberculis conicis 5–6-fariis; aculeis 6–8 setaceis brevibus radiantibus albidis, centrali singulo multo longiore fusco; floribus magnis; petalis angustis recurvatis; seminibus tuberculatis.

On the Nueces, in southern Texas: flowers May and June. — Stems $1\frac{1}{2}$–6 inches long, one inch thick; radial spines 4–5 lines long, central one 6–12 lines long, toward the base of the branches shorter. Flower 2–4 inches long.

24. C. PROCUMBENS, E. in Pl. Lindh. 1850: humilis, perviridis; caule diffuso subtereti 4–5-angulato articulato ramosissimo; aculeis 4–6 radiantibus albidis, centrali nullo vel singulo paullo longiore obscuro; floribus magnis; petalis obovato-spathulatis patulis seu subrecurvis; seminibus tenuissime verrucosis.

On the Rio Grande, below Matamoras: flowers May and June. — Similar to the last; but more slender, 6–8 lines in diameter; radial spines 1–2 lines long, central one, if present, 2–3 lines long. Flower above 3 inches long.

§ 4. GRACILES.

25. C. TUBEROSUS, Poselger: e radice tuberosa tenuissimus, teres, sursum incrassatus, demum articulatus, 8-costatus; aculeis minutis setaceis, 9–12 radiantibus, centrali singulo longiore sursum adpresso; flore subterminali; seminibus minutis scrobiculatis.

Between Laredo and Mier on the Rio Grande. Tuberous root $\frac{1}{2}$–$1\frac{1}{2}$ inches thick. Stem above 4–8 lines thick; radial spines hardly 1 line, central ones 2–3 lines long. Seed smaller than in any other *Echinocereus*, 0.4 line long, with the tubercles confluent.

Subgen. 2. EUCEREUS. Caulis elongatus: fasciculi aculeorum steriles et florigeri similes: floris tubus elongatus, sæpissime aculeolis capillaceis munitus: stigmata pallida: semina lævia seu raro rugosa: embryo hamatus.

26. C. Emoryi, E. in Sill. Journ. 1852: prostratus; ramis adscendentibus 15-costatis; areolis confertis; aculeis setaceis rigidis flavis, radialibus 40–50 stellatis, centrali unico longiore robustiore; flore flavo brevius- [287]
culo; bacca aculeatissima; seminibus magnis lucidis.

On hills near San Diego, California, growing in thick patches. — Stems several feet long; branches 6–9 inches high, 1½ inches in diameter. Fruit very spinose, with seeds over one line in length.

27. C. variabilis, Pfeiff.: erectus, 3–4-angulatus; areolis remotis; aculeis 4–6 brevibus radiantibus, 2–4 interioribus validis elongatis inæqualibus divaricatis, centrali deflexo; flore magno albo nocturno; bacca coccinea aculeolata; seminibus magnis lævibus.

On the lower Rio Grande: flowers in May and June. — Well known from all parts of tropical America. Stem 3 to 10 feet high, 2 inches in diameter; larger spines 12–18 lines long. Fruit 2–3 inches long, nearly 2 inches in diameter.

28. C. Greggii, E. in Wisliz. Rep.: gracilis, e radice crassa napiformi erectus; ramis 3–6-angulatis, rufescentibus; areolis confertis; aculeis e basi bulbosa abrupte subulatis brevissimis nigricantibus, radialibus 6–9, centralibus 1–2; floris elongati albidi tubo aculeolis capillaceis flexuosis munito; bacca sessili obovata apice rostrata; seminibus rugosis. Var. *α*. cismontanus: areolis elongatis; petalis latioribus. Var. *β*. transmontanus: areolis ovato-orbiculatis; petalis angustioribus.

From Western Texas to Sonora, and south to Chihuahua: flowers May and June. — Root a large fleshy tuber, sometimes 6 inches in diameter. Stems 2–3 feet high, 9–12 lines thick, usually 4- or 5-angled; spines ½–1 line long, very sharp; lower ones longer. Flower 6 or 8 inches long, 2–2½ wide. Fruit 1–1½ inches long. Seed 1¼–1½ lines long.

Subgen. 3. Lepidocereus. Caulis elongatus: fasciculi aculeorum steriles et florigeri similes: floris tubus brevior squamosus: phylla numerosissima: stigmata pallida: semina lævia: embryo hamatus.

29. C. giganteus, E. in Emory's Rep. 1848: erectus, elatus, parce erecto-ramosus, 18–21-costatus; aculeis 12–16 radialibus inæqualibus, centralibus sub-6 robustis basi bulbosis corneis basi nigris cæteros superantibus, infimo longiore deflexo; floribus subterminalibus albidis; bacca obovata demum 3–4-valvi.

From the lower Gila north to Williams's River (better known among Western travellers as Bill Williams's [288]
Fork), and south into Sonora: flowers May-July; fr. July and August. — A now well-known plant to travellers and botanists, 30–50 feet high, 1–2 feet in diameter; central spines 1½–2½ inches long. The yellowish-white flower 3–4 inches long. Fruit 2–3 inches long, often pear-shaped, and opening with 3 or 4 irregular recurved valves.

30. C. Thurberi, E. in Sill. Journ. 1854: caulibus erectis vel adscendentibus pluribus elatioribus articulatis 13–14-costatis; aculeis 7–15 gracilibus fusco-atris valde inæqualibus; ovario tuboque imbricato-squamato; bacca globosa magna.

Sonora, west of the Sierra Madre: flowers June and July. — Stems 5–15 from one root, 10–15 feet high, 4–6 inches in diameter; spines slender, flexible, from 5–18 lines long. Flowers 3 inches long, white. Fruit like a large orange, of delicious flavor.

Subgen. 4. Pilocereus. Caulis elatus: fasciculi aculeorum steriles a floriferis tenuioribus longioribus distincti: floris tubus brevis squamosus: phylla pauciora: stigmata pallida: semina lævia: embryo hamatus (in specie nostra !).

31. C. Schottii, E. in B. C. R.: caulibus erectis vel adscendentibus pluribus elatioribus articulatis 4–7-costatis; areolis in articulis sterilibus remotis; aculeis brevibus robustis, radialibus 4–6, centrali unico; areolis in articulis floriferis confertis; aculeis 15–25 longioribus setaceis flexuosis e rubello cinereis; floribus carneis minoribus, tubo gracili decurvo; bacca parva.

Sonora, towards Santa Magdalena: flowers July. Stems 8–10 from the same base, often growing in dense clusters, 8 or 10 feet high, with 2–4 articulations, 4 or 5 inches in diameter. Spines of the sterile part of the plant 3–4 lines long, on the fertile joints 1–4 inches long, pendulous, forming a reddish-gray beard, in which the flower (not 2 inches long) is somewhat hidden. Seeds large: cotyledons hooked, exactly as in the last two species. This is evidently a *Pilocereus*, but with the seed of a true *Cereus*, thus reuniting the former with the latter.

Tribus II. ROTATÆ, Miquel.

Aphyllæ seu foliosæ. Flores tubo abbreviato subrotati. Cotyledones facie versus hilum spectantes seminis lateri contrariæ (incumbentes).

IV. OPUNTIA, Tourn. [289]

Ovarium sepalis subulatis caducis axillâ pulvilligeris instructum. Semina magna, compressa, discoidea, sæpe marginata, albida. Cotyledones foliaceæ, circa albumen curvatæ, plerumque incumbentes. — Plantæ articulatæ; articulis complanatis seu teretibus plus minus tuberculatis; foliis subulatis caducis axillâ pulvillos setosos plerumque aculeiferos gerentibus; aculeis apice retrorsum hispidis.

ANALYSIS.

I. Petala parva, subulata, suberecta. — Subgen. 1. STENOPUNTIA.

II. Petala lata, obovata seu obcordata.

1. Articuli complanati: embryo circa albumen parcum spiraliter convolutus. — Subgen. 2. PLATOPUNTIA.

A. Bacca succosa: margo seminum plerumque angustior (*Sarcocarpeæ*).

a. Glabræ. * Bacca parva subglobosa. — § 1. *Microcarpeæ*.

** Articuli magni: aculei pauci compressi. — § 2. *Grandes*.

*** Articuli minores: aculei setiformes. — § 3. *Setispinæ*.

**** Articuli minores: aculei pauci, robusti, teretes. — § 4. *Vulgares*.

b. Pubescentes. — § 5. *Pubescentes*.

B. Bacca sicca: margo seminum plerumque latissimus. — § 6. *Xerocarpeæ*.

2. Articuli cylindracei: embryo circa albumen copiosius subcircularis. — Subgen. 3. CYLINDROPUNTIA.

A. Articuli abbreviati, clavati. — § 1. *Clavatæ*.

B. Articuli cylindracei, elongati. — § 2. *Cylindricæ*.

Subgen. 1. STENOPUNTIA, E. in B. C. R. Articuli complanati: flores parvi: petala subulata: stigmata pauca.

1. O. STENOPETALA, E. l. c.: prostrata; articulis magnis; aculeis 1–3 cum minoribus 1–3 ancipitibus deflexis atrofuscis; ovario pulvillis confertis stipato; sepalis petalisque subulatis suberectis; stylo inflato; stigmate simplici.

On the battle-field of Buena Vista, south of Saltillo. Nearly allied to the Mexican *O. grandis*, Hort. Angl., which has very similar flowers, but is an erect plant, with few and white spines, and 2 or 3 acute stigmata.

Subgen. 2. PLATOPUNTIA, E. l. c. Articuli complanati: flores magni: bacca pulposa vel rarius sicca: [290] semina late marginata: embryo plusquam circularis circa albumen parcum spiraliter convolutus: cotyledones semper contrariæ.

§ 1. MICROCARPEÆ: suberectæ: aculei plurimi, colorati: bacca parva subglobosa.

2. O. STRIGIL, E. in B. C. R.: suberecta, articulis ovatis orbiculatisve; pulvillis confertis; aculeis 5–8 radiantibus deflexis rufis apice flavis; bacca parva late umbilicata rubra; seminibus parvis anguste marginatis.

Between the Pecos and El Paso. — Plant 2 feet high; joints 4–5 inches long; spines an inch or less in length. Fruit 6–7 lines long.

§ 2. GRANDES: erectæ seu procumbentes: articuli magni: aculei pauci, validi, compressi, plerumque colorati: bacca major vel magna, plerumque ovata.

* *Subinermes.*

3. O. FICUS-INDICA, Mill: cultivated south of the Rio Grande, under the name *Nopal Castillano*.

** *Flavispinæ.*

† *Erectæ.*

4. O. TUNA, Mill: cultivated about the old missions in the southern parts of upper California, under the name *Tuña*. Specimens gathered at Beaufort, on the coast of South Carolina (probably introduced), may belong here.

5. O. ENGELMANNI, Salm: erecta, grandis; articulis obovatis; pulvillis remotis setas stramineas rigidas inæquales aculeosque 1–3 compressos stramineos basi rufos gerentibus; floris flavi intus rubelli ovario subgloboso; stigmatibus 8–10; bacca obovata late umbilicata; seminibus minoribus.

From the Canadian River to the mouth of the Rio Grande, and westward from the Gulf to Chihuahua and El Paso; flowers May and June. — Plant 4–6 feet high; joints a foot long or less; leaves subulate, 3–4 lines long; larger spines 1–1½ inches long. Flower 2½–3 inches in diameter. Fruit usually 2 inches long, 1½ in diameter, juicy, but of a somewhat nauseous taste. Seeds 1½–2 lines in diameter. A plant observed by Dr. Blackie on Bayou Bœuf, western Louisiana, 5½ feet high, joints 9 inches long, reddish-yellow flowers, is probably this species.

O. Lindheimeri, E. Plant. Lindh., is partly this same plant, partly a hybrid form between it and perhaps [291] *O. Rafinesquii*, with narrow clavate fruit.

O. ENGELMANNI, var.? CYCLODES, E. & B. in P. R. R.: articulis orbiculatis; aculeis validioribus subsingulis; bacca parva globosa; seminibus majoribus.

On the upper Pecos, in New Mexico. Joints 6–7 inches, and fruit 1 or 1¼ inches in diameter.

O. DULCIS, E. in B. C. R., is a doubtful plant, of which we have not material enough. It has been found near the middle course of the Rio Grande, near Presidio del Norte, etc. It is similar to *O. Engelmanni*, and may be a form of it; but it is lower, more spreading, with a similar but very sweet fruit, and small regular seeds.

The following may be considered as a subspecies : —

O. OCCIDENTALIS, E. & B. in P. R. R.: erecta, patulo-ramosissima; articulis grandibus obovatis vel rhomboideis; pulvillis remotis setas graciles confertas et aculeos 1–3 validos compressos deflexos albidos basi obscuriores et inferiores paucos graciliores gerentibus; floris flavi intus rubelli ovario obovato; bacca obovata late umbilicata; seminibus majoribus.

On the western slope of the California mountains, near San Diego and Los Angeles: flowers June. — Plant 4 feet high, forming large thickets; the joints 9–12 inches long; pulvilli with very fine closely-set bristles; spines about an inch long. Apparently distinct from *O. Engelmanni* by its manner of growth, the very fine bristles, and the larger seeds.

There are also some indications of another form, growing on hills and plains near San Diego, California, and on the neighboring sea-beach, with higher and more upright growth, and coarser bristles on the pulvilli, but which I cannot well distinguish from *O. Engelmanni*. I have seen no fruit or seed of it.

6. O. CHLOROTICA, E. & B. in P. R. R. : caule erecto aculeis flavis numerosissimis fasciculatis armato; articulis orbiculato-obovatis pallidis; pulvillis subremotis setas diffornes confertas aculeosque 3–6 inæquales compressos stramineos gerentibus; floris flavi ovario pulvillis confertis stipato; petalis spathulatis.

Western Colorado country, between New Mexico and California, from the San Francisco mountains to Mojave Creek. — Plant 4–6 feet high, forming large and sometimes spreading bushes; the trunk covered with [292] spines 1–2 inches long; joints 8–10 by 6–8 inches in length; spines ½–1½ inches long. Ovary with nearly 50 pulvilli, while the foregoing species have not more than 20.

† † *Procumbentes.*

7. O. PROCUMBENS, E. & B. l. c. : prostrata; articulis orbiculato-obovatis grandibus pallide viridibus; pulvillis remotis setas stramineas rigidas valde inæquales et aculeos 2–4 validos compressos angulatos stramineos basi obscuriores gerentibus.

San Francisco mountains to Cactus Pass, in western New Mexico. Joints 9–13 inches long, always edgewise; pulvilli 1½–2 inches apart; spines 1–2 inches long. Similar to *O. Engelmanni*, but prostrate, with more distant pulvilli and stouter spines. No flower or fruit seen.

8. O. ANGUSTATA, E. & B. l. c.: prostrata vel adscendens; articulis elongato-obovatis versus basin angustatis; pulvillis remotis setas fulvas graciles aculeosque paucos (2–3) validos compressos stramineos seu albidos versus basin rufos deflexos gerentibus; bacca obovata tuberculata; seminibus magnis.

From Zuni, west of the Rio Grande, westward to the Cajon Pass, in the California mountains. — Joints 6–10 inches long, only 3 or 4 wide. Spines similar to those of the last species; bristles much more delicate. Fruit 1½ inches long; the umbilicus flat, but immersed. — Well distinguished by the shape of the joints.

* * * *Fulvispinæ.*

9. O. MACROCENTRA, E. in B. C. R.: adscendens; articulis magnis suborbiculatis tenuibus; pulvillis subremotis setas graciles breves fulvas gerentibus, summis solum aculeos 1–2 prælongos subcompressos fusco-atros proferentibus; floris flavi ovario ovato; stigmatibus 8; seminibus majusculis.

Sand-hills on the Rio Grande near El Paso: flowers May. — Two or three feet high, with very striking round joints, 5–8 inches in diameter, and blackish spines as much as 2 or 3 inches long. Nearly allied to the next species.

10. O. PHÆACANTHA, E. in Plant. Fendl.: diffusa, adscendens; articulis obovatis crassis glaucescentibus; pulvillis subremotis setas graciles stramineas seu fuscatas longiores gerentibus, plerisque aculeos 2–5 plus minus compressos fuscos proferentibus; floris flavi ovario abbreviato; stigmatibus 8; bacca cuneata pyriformi; seminibus majusculis.

Var. *α.* NIGRICANS: aculeis brevioribus acute angulatis et nigricantibus. [293]

Var. *β.* BRUNNEA: pulvillis remotioribus; aculeis longioribus obtuse angulatis brunneis sursum albidis.

Var. *γ.* MAJOR: suborbiculata; pulvillis remotis; aculeis brevioribus paucioribus pallidioribus.

New Mexico: flowers May. Var. *α.* is found on the Rio Grande near Santa Fé; *β.* in similar sandy locations near El Paso; and *γ.* in mountainous regions near Santa Fé. — Joints 4–6, or in *γ.* even 8 inches long; spines mostly 1–2 inches in length. Flower about 2 inches in diameter, with a short ovary. Fruit 1¼–1½ inches long, slender, much contracted at base so as to appear almost stipitate.

O. MOJAVENSIS, E. & B. in P. R. R.: prostrata; articulis grandibus suborbiculatis; pulvillis remotis; setis fulvis; aculeis 3–6 validis infra fuscis.

On the Mojave, west of the Colorado. — The material is too scanty to make out where it belongs; but perhaps it is only a form of *O. phæacantha.*

11. O. CAMANCHICA, E. & B. in P. R. R.: prostrata; articulis adscendentibus majusculis suborbiculatis; pulvillis remotis plerisque armatis; setis stramineis fulvisve parcis; aculeis 1–3 compressis fuscis apice pallidioribus, superioribus elongatis suberectis, cæteris deflexis; bacca ovata late umbilicata; seminibus majusculis angulatis hilo excisis.

Llano Estacado, on the Upper Canadian River. A large, extensively spreading plant; the joints 6–7 inches long; spines 1½–2 or even 3 inches long. Fruit large, juicy. Seeds 2–3 lines in diameter, very irregular and deeply notched at the hilum.

12. O. TORTISPINA, E. & B. l. c.: prostrata; articulis adscendentibus majusculis suborbiculatis; pulvillis subremotis; setis stramineis seu fulvis; aculeis 3–5 majoribus angulatis sæpe tortis albidis cum 2–4 gracilioribus; bacca ovata late umbilicata; seminibus majusculis orbiculatis.

On the Camanche plains, east of the elevated plateau of the Llano Estacado. — Similar in size and habit to the last species, its western neighbor, with more numerous spines than any other of our *Opuntiæ* with juicy fruit. Seeds regular, and only very slightly notched at the hilum.

§ 3. SETISPINÆ: adscendentes: articuli plerumque minores: aculei pauci, teretes seu vix angulati, graciles, flexiles, pallidi: bacca minor. [294]

13. O. TENUISPINA, E. in B. C. R.: articulis majusculis obovatis basi attenuatis læte viridibus; pulvillis subapproximatis setas graciles breves fulvas gerentibus plerisque armatis; aculeis 1–2 elongatis albidis cum 1–4 brevioribus inferioribus; floris flavi ovario clavato; petalis obovatis retusis; bacca oblonga profunde umbilicata; seminibus minoribus.

Sand-hills near El Paso: flowers May. — Joints 3–6 inches long, 2–4 wide; leaves very slender, hardly 2 lines long; upper spines suberect or spreading, 1½–2½ inches long. Flower 2½–3 inches in diameter. Seeds less than 2 lines in diameter, very irregular. — Similar in many respects to *O. phœacantha*, which grows with it; but readily distinguished by the spines and fruit.

14. O. SETISPINA, E. in Salm, H. D.: articulis suborbiculatis parvis glaucis; pulvillis confertis setas flavidas gerentibus, omnibus armatis; aculeis 1–3 longioribus subangulatis et 3–7 brevioribus plus minus deflexis, omnibus gracillimis.

Pine woods in the mountains west of Chihuahua, Dr. Wislizenus. — Joints not over 2 inches long; pulvilli only 3–4 lines apart; longer spines 1–1½ inches long, very slender, like bristles. Flower and fruit unknown.

15. O. FILIPENDULA, E. in B. C. R.: glauca; radicibus nodoso-incrassatis; articulis minoribus orbiculatis seu obovatis seu oblanceolatis tenuibus; pulvillis approximatis setas virescenti-flavas graciles numerosas gerentibus armatis vel inermibus; aculeis, si adsunt, 1–2 elongatis subangulatis cum 1–2 minoribus, omnibus albidis; floris purpurascentis ovario gracili; stigmatibus 5; seminibus minoribus tumidis.

Alluvial bottoms of the Rio Grande near El Paso, and eastward on the Pecos: flowers May and June. — The long knotted roots, the small bluish joints, with the very small leaves and very long bristles, together with the purple flower, and thick very narrowly margined seeds, distinguish this species from all others. Plant 6–12 inches high; joints 1½–3 inches long, 1–2 wide; pulvilli 4–6 lines apart; lower spines 1–2 inches long. Flower 2½ inches in diameter. Seed hardly 2 lines in diameter.

§ 4. VULGARES: procumbentes vel adscendentes: articuli plerumque minores: aculei validi, subteretes vel nulli, albidi vel obscuriores: bacca clavata. [295]

16. O. RAFINESQUII, E. in P. R. R.: diffusa; radice fibrosa; articulis obovatis vel suborbiculatis perviridibus, foliis elongatis patulis; pulvillis subremotis setas graciles rufas gerentibus plerisque inermibus; aculeis paucis marginalibus validis rectis singulis erectis patulisve, uno alterove minore deflexo subinde adjecto, rufo variegatis; alabastro acuto; ovario clavato pulvillis 20–25 stipato; petalis 10–12; stigmatibus 7–8; bacca clavata.

Var. MICROSPERMA: subinermis; seminibus minoribus angustius marginatis.

Sterile, sandy, or rocky soil in the Mississippi valley, from Kentucky to Missouri, and from Minnesota southward: flowers May and June. — Joints 3–5 inches long; leaves 3–4 lines long; spines 9–12 lines long, sometimes entirely wanting. Flowers 2½–3½ inches in diameter, yellow, often with a red centre. Seed 2½ lines, or in the variety less than 2 lines in diameter. — This species had been confounded with the eastern *O. vulgaris* by all our botanists, with the exception of Rafinesque, who pretended to distinguish three species, — namely, *O. humifusa*, *O. cæspitosa*, and *O. mesacantha* (sometimes erroneously accredited to Nuttall), — which cannot be made out, and which I have again united under their author's name.* — The following is probably only a southern variety of this species: —

* The following extract is from a note by Dr. Engelmann in the "Bulletin of the Torrey Botanical Club," September, 1871, II. p. 34. — EDS.

I have now had Professor Wood's specimen of *Opuntia* from Westchester Co., one from New Jersey sent by Mr. Meehan, and a third from New England, probably Massachusetts,

O. GRANDIFLORA, E.: subadscendens; articulis majusculis; pulvillis remotis; setis tenuissimis; aculeis subnullis; floris grandis ovario elongato; petalis sub-10 latissimis; stigmatibus 5; bacca elongata clavata.

On the Brazos, Texas. — Joints often 5–6 inches long; pulvilli nearly an inch apart. Flowers 4½–5 inches in diameter, red in the centre; petals 2 inches long or more, and 1½ wide.

Dr. Bigelow collected, on his tour from Arkansas to Santa Fé, several forms, which, though somewhat distinct, are perhaps not entitled to be considered species. The true *O. Rafinesquii* does not seem to occur west of the western line of Missouri and Arkansas. The western forms or subspecies are: —

O. CYMOCHILA, E. & B. in P. R. R.: diffusa; articulis orbiculatis; pulvillis subremotis stramineo-seu fulvo-setosis plerisque armatis; aculeis 1–3 robustioribus albidis basi fulvis patentibus deflexisve, additis sæpe 2–3 minoribus; stigmatibus 8; bacca obovata; seminibus undulato-marginatis majusculis. [296]

Var. β. MONTANA: subinermis; stramineo-setosa.

Along the Canadian River east of the Llano Estacado, and on that plain. Var. β. near Albuquerque. — Joints 2½–3 inches in diameter, in β. larger; longer spines 1–2 inches long. Fruit short, pulpy, sweet. Seed 2½ lines in diameter, with a very sharp irregularly wavy or twisted border. — The var. β. seems to unite the common *O. Rafinesquii* with this form.

O. STENOCHILA, E. & B. l. c.: prostrata; articulis obovatis; pulvillis remotis stramineo-setosis, superioribus solum armatis; aculeis singulis albidis patulis, 1–2 minoribus deflexis sæpe adjectis; bacca obovata clavata; seminibus crassis anguste marginatis.

Zuni, western New Mexico. — Joints 4 inches long and 3 wide; spines 1–1¼ inches long. Fruit green or pale red, very juicy, 1½ or sometimes even 2½ inches long. Seeds quite peculiar, regular, much thicker in proportion than those of most other *Opuntiæ*, and with a very narrow edge. — Another form, with smaller and rounder joints, more spines, smaller fruit, but similar seeds, was found in the same neighborhood.

All the forms described above have fibrous roots. The following are principally characterized by their bulbous or tuberous roots, but can hardly be otherwise distinguished from the forms already described. Both are found westward of the range of *O. Rafinesquii* proper, and may be considered as subspecies, the peculiarities of which are readily propagated by seeds.

O. MACRORHIZA, E. in Plant. Lindh. part 1: prostrata, sæpe adscendens, radicibus tuberosis; articulis obovato-orbiculatis perviridibus; pulvillis subremotis rufo-setosis, superioribus solum armatis; aculeis singulis validis sæpe variegatis patulis, 1–2 gracilioribus deflexis subinde additis; alabastro acuminato; petalis circiter 8 sulphureis basi miniatis; stigmatibus 5; bacca obovata basi clavata, umbilico lato; seminibus subregularibus compressis minoribus.

Sterile, rocky places on the upper Guadaloupe River, in Texas: flowers May and June. — Roots in young specimens fusiform, in old ones enlarged to fleshy tubers, sometimes 2 or 3 inches in diameter. Joints 2½–3½ inches long; the leaves and bristles the same as in *O. Rafinesquii*. Flowers 3 inches in diameter. Fruit green or pale purple, smaller and sweeter than that of *O. Rafinesquii*.

O. FUSIFORMIS, E. & B. l. c.: subprostrata; radicibus elongato-fusiformibus; articulis orbiculatis; pul- [297]
villis setas elongatas virescenti-fuscas gerentibus, plerisque vel solum superioribus armatis; aculeis 2–3 gracilibus albidis deflexis seu patentibus; floribus minoribus; stigmatibus 8; bacca ovata; seminibus majusculis subregularibus.

Kansas and Nebraska, in the regions of the Cross-Timbers, from the Canadian to the Big Bend of the Missouri. — Roots elongated tubers ½–1 inch in diameter; joints about 3–4 inches long; spines an inch or a little more in length, slenderer and paler than in *O. Rafinesquii*. Flowers 2–2½ inches in diameter. Seed 2¾ lines wide. This plant has been distributed by me under the name of *Opuntia bulbosa*.

17. O. FUSCO-ATRA, E. in P. R. R.: diffusa; articulis orbiculato-obovatis tuberculatis; pulvillis subremotis magnis griseo-tomentosis, inferioribus solum inermibus; setis numerosis robustis longiusculis fuscis; aculeis subsingulis robustis fusco-atris suberectis, altero breviore deflexo sæpe adjecto; floris flavi ovario conico pulvillos 12–18 fulvo-villosos et fusco-setosos gerente; stigmatibus 5.

Sterile places in prairies, west of Houston, Texas: flowers May. — The stout brown, or above almost black spines, and the thick bunches of unusually stout brown bristles on the small joints, give this plant a very distinct appearance.

furnished by Professor Gray, side by side in cultivation with our Missouri and Illinois *O. Rafinesquii*. It is certainly less spiny, and sometimes the flower is smaller than in our plant, but the deep green color, the long spreading leaves, and the bright brown bristles, especially on the older joints, on which they increase in number and length to considerable bunches, are characteristic of the plant. With them I have growing the true *O. vulgaris*, sent by Dr. Schott from the banks of the Potomac, and probably not found north of Chesapeake Bay, with thicker light green joints, shorter, thicker, more adpressed leaves, and small bunches of short, thin, greenish-yellow bristles. This is the plant which is cultivated in Europe under that name, and has become naturalized in northern Italy, and which I have described and figured as such in Vol. IV. Pacif. R. Reports.

Joints 2½–3 inches long; pulvilli 6–9 lines apart; bristles 2–3 lines long; spines 1–1¼ inches long, the lower one, when present, about half as long, but hardly less stout. Flower nearly 3 inches in diameter; ovary an inch long, rather slender, its pulvilli covered with long grayish-brown wool, and the upper ones with a few bright-brown bristles.

18. O. VULGARIS, Mill.: diffusa, prostrata; radice fibrosa; articulis obovatis seu suborbiculatis crassis læte seu pallide viridibus plerumque inermibus; foliis ovatis cuspidatis fere adpressis; pulvillis subremotis parvis subimmersis setas paucas abbreviatas virescenti-stramineas gerentibus; aculeis rarissimis singulis robustis variegatis suberectis; alabastro subgloboso obtuso; ovario clavato pulvillis sub-10 stipato; petalis sub-8; stigmatibus 5; bacca obovata clavata; seminibus regularibus crassis crasse marginatis.

From the southeastern coast of Massachusetts to Georgia and Florida; apparently only in the low countries east and southeast of the Alleghany Mountains, generally not far from the sea-coast: flowers May and June. — Joints 2–4 inches long and 2–2½ in diameter, rather thick and fleshy. Leaves 2–2½ lines long, generally appressed, only in very vigorous specimens more patulous: spines, when present, less than 1 inch long, but stout. [298] Flower about 2 inches in diameter, pale yellow. Seed 2½ lines in diameter. It seems to be well distinguished from *O. Rafinesquii* (which grows only west of the Alleghanies) by the smaller size, paler color, small pulvilli, usually the absence of spines, the smaller flower, with all the parts less numerous, and especially by the short, thick, and more or less appressed leaves.

§ 5. PUBESCENTES: erectæ seu procumbentes: articuli pubescentes: folia minuta: aculei subnulli.

* *Flavifloræ.*

19. O. MICRODASYS, Lehm.: erecto-patula; articulis oblongis obovatis seu orbiculatis pubescentibus læte viridibus; foliis minutis; pulvillis confertis inermibus lanam flavidam setasque numerosas gracillimas flavas gerentibus.

Only south of the lower Rio Grande, near Rinconada, etc. — Plant 2–4 feet high; joints 2–3 inches long, 1½–2 wide; pulvilli ¼–⅓ of an inch apart.

20. O. RUFIDA, E. in B. C. R.: erecto-patula; articulis late-obovatis seu suborbiculatis pubescentibus; foliis longe acuminatis; pulvillis confertis setas rufidas graciles numerosissimas gerentibus inermibus; floris flavi ovario obovato pulvillis numerosis instructo; stigmatibus 7 in capitulum congestis.

Common about Presidio del Norte, on the Rio Grande: flowers May. — Stem 2–4 feet high, much branched; joints 3–6 inches long; leaves 2½ lines long. Flower 2½ inches in diameter, with 40–50 pulvilli on the ovarium. — Apparently near *O. microdasys* and *O. puberula;* distinguished from the former by the rounded joints, larger leaves, and red-brown bristles; from the latter by the entire absence of spines, and of the purplish spot which in that species surrounds the pulvillus. Further investigations are necessary to decide about these closely allied forms, as about most species of this intricate genus.

* * *Rubrifloræ.*

21. O. BASILARIS, E. & B. l. c.: humilis; articulis obovatis seu triangularibus glaucescentibus pubescentibus e basi proliferis; foliis minutis; pulvillis subconfertis fulvo-villosis setas gracillimas demum numerosissimas fulvidas et subinde aculeolos setiformes caducos gerentibus; floris purpurei ovario obovato pulvillis plurimis instructo; stigmatibus 8 in capitulum congestis; bacca obovata late umbilicata (sicca?); seminibus magnis crassis sub- [299] regularibus.

On Williams's River, the Colorado, and the Mojave, and down to the Gila: flowers April and May. — Habit very different from any other of our *Opuntiæ;* the stout obovate or fan-shaped joints (5–8 inches long) originate from a common base, forming a sort of rosette. Leaves only one line long, 4–6 lines apart; pulvilli red-brown, somewhat immersed. Flower about 2½ inches in diameter; ovary with 40–60 pulvilli. Fruit apparently dry, thereby approaching the next section. Seed 3 lines in diameter, 2 lines thick.

Mr. Schott has observed, on the dividing ridge of the California mountains, west of the mouth of the Gila, and again in the Santa Cruz Valley, Sonora, a very similar but suberect species, 3 feet high, spineless, inclined to assume a purplish hue, which he seems to have confounded with *O. basilaris.* Can it be *O. rufida,* or is it an undescribed species?

§ 6. XEROCARPEÆ: diffusæ: articuli suborbiculati vel tumidi: aculei plurimi: bacca sicca aculeolata: semina eburnea, magna, plerumque latissime marginata.

* *Articuli compressi suborbiculati.*

22. O. HYSTRICINA, E. & B. l. c.: diffusa; articulis obovato-orbiculatis; pulvillis subconfertis setas pallidas rutilasve gerentibus, omnibus armatis; aculeis 5–8 superioribus validis elongatis angulatis seu tortis patulis vel deflexis, inferioribus 5–7 gracilioribus radiantibus; bacca ovata aculeolata, umbilico planiusculo; seminibus maximis.

West of the Rio Grande, to the San Francisco mountains. — Joints 3–4 inches long; pulvilli 5–6 lines apart, unusually large; longer spines 1½–3 and even 4 inches long, brownish; lower radiating ones white, 4–9 lines long.

Fruit an inch long; upper pulvilli with 4–6 bristly spines. Seeds 3½ lines in diameter, among the largest in this genus.

23. O. MISSOURIENSIS, DC. (*Cactus ferox*, Nutt. Gen.) : prostrata ; articulis obovatis vel suborbiculatis tuberculatis ; foliis minutis ; pulvillis subconfertis stramineo-setosis, omnibus armatis ; aculeis 5–10 exterioribus radiantibus setiformibus albidis, 1–5 interioribus robustis albidis seu rufescentibus ; floris flavi intus aurantiaci ovario obovato vel subgloboso spinuloso ; stigmatibus 5–10 viridibus ; bacca spinosa, umbilico plano; seminibus magnis irregularibus.

Var. *α.* RUFISPINA, E. & B. : articulis orbiculatis ; aculeis interioribus 3–5 validis fuscis ; bacca ovata. [300]

Var. *β.* PLATYCARPA, E. : articulis obovato-orbiculatis; aculeis interioribus subsingulis validis fuscis; bacca depresso-globosa late umbilicata.

Var. *γ.* MICROSPERMA, E. : articulis aculeisque præcedentis ; bacca ovata breviter aculeolata ; seminibus minoribus anguste marginatis.

Var. *δ.* SUBINERMIS, E. : articulis elongato-obovatis, pulvillis subremotis inferioribus inermibus, superioribus aculeos paucos breves gerentibus.

Var. *ε.* ALBISPINA, E. & B. : articulis late obovatis ; aculeis 6–12 omnibus albis gracilioribus ; bacca ovata.

Var. *ζ.* TRICHOPHORA, E. & B. : articulis ovatis ; pulvillis confertis ; aculeis 10–18 setiformibus (in articulis vetustis numerosioribus) capillaceis flexuosis ; bacca ovata ; seminibus maximis.

From the upper Missouri to the Canadian ; principally occupying the western plains, but also on the mountains towards Santa Fé and west of it. — The last-mentioned variety (which I would consider a distinct species, were it not for the var. *albispina*, which seems to unite it with the others) has been found only on the mountains near Albuquerque : all the other forms occur on the upper Missouri, and *α.* and *ε.* also on the Canadian. Other and intermediate forms of this variable but nevertheless well-characterized species will no doubt be found in the wide territory inhabited by it. It flowers in May and June. — Joints 2–4, rarely 4–6 inches long, and 2–3½ inches wide, light green ; leaves 1½–2 lines long ; larger spines 1–1½, rarely 2 inches long, in *δ.* not more than 3–6 lines long. Flowers 2–3 inches in diameter, with short green stigmata forming a compact head. Fruit 1–1¼ inches long, with shorter or longer spines, and a rather shallow umbilicus. Var. *β.* has a remarkably large flat fruit. Seed generally about 3 lines, but in *γ.* only 2 lines, in diameter.

24. O. SPHÆROCARPA, E. & B. l. c. : diffusa; articulis orbiculatis tuberculatis; pulvillis confertis stramineo-setosis plerisque inermibus, summis solum aculeos 1–2 deflexos patulosve majores gerentibus, adjectis sæpe 1–3 brevioribus ; bacca globosa vix aculeolata; seminibus mediis.

Mountains near Albuquerque, New Mexico. — Joints 3 inches in diameter, strongly tuberculated; pulvilli 4 or 5 lines apart; spines 6–12 lines long, reddish-brown, often single or 2 or three together, with or without [301] smaller ones, which never occurs in any form of *O. Missouriensis*, where a large number of small setaceous spines is found, whether larger ones are present or not. Fruit 9 lines in diameter, with a small flat umbilicus. Seeds 2½ lines in diameter.

* * *Articuli tumidi ovati.*

25. O. ERINACEA, E. & B. l. c. : adscendens ; articulis ovatis seu teretiusculis; pulvillis confertissimis omnibus armatis ; aculeis 5–10 gracilibus rubellis, 3–5 elongatis ; bacca ovata aculeolata ; seminibus magnis subregularibus.

Near the Mojave, between the Colorado and the California mountains. — Joints 2–2½ inches long, 1–1½ broad, and ½–¾ thick, sometimes almost cylindrical, densely covered with large white pulvilli, which are only 2–3 lines apart. Spines 6–14 or even 20 lines long, slender but stiff. Fruit an inch or more in length. Seeds nearly 3 lines in diameter.

26. O. ARENARIA, E. in B. C. R. : adscendens ; articulis obovatis compressis seu teretiusculis tuberculatis; foliis minutis ; pulvillis subconfertis pallide setosis ; aculeis 1–4 robustioribus albidis fuscatisve, cum inferioribus brevioribus 2–6 albis; floris sulphurei ovario obovato ; petalis emarginatis ; stigmatibus 5 ; bacca oblonga spinulosa ; umbilico infundibuliformi; seminibus magnis irregularibus.

Sandy bottoms of the Rio Grande near El Paso : flowers May. — Spreading 2–3 feet, ½–1 foot high ; roots stout, creeping horizontally ; joints 1½–3 inches long, 1–2 inches wide, and ½–¾ thick, more strongly tuberculated than the allied species ; leaves only a line long ; pulvilli 3–5 lines apart, very bristly, especially on the old joints ; upper spines 9–15 lines long. Flower 2–2½ inches in diameter. Fruit about an inch long. Seeds 2½–3 lines in diameter. This is the only one of our Cactaceæ on which the Cochenille has been found.

27. O. FRAGILIS, Haw. (*Cactus fragilis*, Nutt.) : subdecumbens ; articulis parvis ovatis subcompressis tumidis vel subglobosis vix tuberculatis nitide viridibus ; foliis minutis ; pulvillis subconfertis magnis albo-tomentosis, vix setulosis ; aculeorum 1–4 robustiorum summo valido angulato fuscato porrecto, ceteris debilioribus pallidioribus patulis seu radiantibus ; aculeis inferioribus 2–6 gracilibus albis radiantibus; floribus minoribus; bacca ovata vix spinulosa, umbilico infundibuliformi ; seminibus paucis magnis subregularibus.

Fertile prairies, or sterile places, on the upper Missouri and Yellowstone, to the mountains and south to Santa Fé. — Size and shape of the joints variable; fruit-bearing joints compressed, 1½–2 inches long, 1–1¼ wide, and ½–¾ thick; others smaller and more tumid. Leaves a line long, hardly longer than the large pulvilli, red. Pulvilli 4–6 lines apart, bristles very few, short, whitish, on the old joints a little more numerous, coarser, dirty yellow. Lower radiating spines 2–4 lines long; central spines 6–10 lines long, the other interior spines 3–8 lines long, often similar to the smaller lower spines. Fruit rather fleshy through the winter, getting dry in spring, nearly an inch long, with 20–25 pulvilli, of which only the upper ones bear a few short spines. Seeds few, usually only 5 or 6 in each fruit, 3 lines in diameter, with a wide and thick obtuse corky margin. — Often sterile, but abundantly propagated by the fragile joints. [302]

28. O. BRACHYARTHRA, E. & B. l. c.: adscendens; articulis ovatis orbiculatisve tumidis sæpe subglobosis tuberculatis; pulvillis confertis parce setulosis; aculeis 3–5 validioribus 1–2 fuscatis patulis vel suberectis, cæteris deflexis; floris parvi ovario subgloboso pulvillos 12–15 vix aculeolatos gerente; stigmatibus 5.

Inscription Rock near Zuni. — The short and tumid joints (10–15 lines long) resemble the joints of a finger; the pulvilli 2–4 lines apart, even in the oldest parts of the plant with very few bristles; longer spines 9–12 lines long, terete. Ovary less than half an inch long. Flower apparently an inch in diameter. — Perhaps too near *O. fragilis;* but in the absence of good flowers and fruit, it is impossible to say whether it does not belong to even a different section, perhaps to the *Glomeratæ*, Salm.

Subgen. 3. CYLINDROPUNTIA, E. in B. C. R. Articuli cylindracei: flores magni vel parvi: bacca plerumque sicca: semina immarginata seu vix marginata: embryo circa albumen copiosius subcircularis; cotyledones contrariæ seu obliquæ, subinde parallelæ.

§ 1. CLAVATÆ: prostratæ: articuli breves, clavati, adscendentes, textura lignosa laxe reticulata: flores flavi majusculi: bacca sicca, pulvillis numerosis setosissimis stipata, floris rudimentis persistentibus coronata.

29. O. CLAVATA, E. in Wisliz. Rep.: articulis breviter clavatis læte viridibus; tuberculis ovatis; foliis subulatis minutis; aculeis albidis scabrellis, interioribus 4–7 complanatis, inferioribus deflexis latioribus supra striatis subtus carinatis, superiore triangulato erecto; aculeis exterioribus 8–10 gracilioribus undique radiantibus; baccæ pulvillis setosissimis; seminibus rostratis. [303]

Santa Fé and Albuquerque, on the plateaux: flowers in June and July. — Dense spreading masses, with joints 1½–2 inches long; tubercles 6–8 lines long; larger spines 6–15 lines long, and the broadest one ¾–1½ lines wide. Flower 2 inches in diameter. Fruit yellow, 1½–1¾ inches long, an inch in diameter, covered with 30–50 large pulvilli. Seed 2½–3 lines in the longest diameter. Cotyledons mostly oblique, or, as in most other *Opuntiæ*, incumbent. (The expression is not etymologically correct, but I use it to designate the direction of the face of the cotyledons towards the radicle.)

30. O. PARRYI, E. in Sillim. Journ. 1852: prostrata; articulis ovatis basi clavatis; tuberculis oblongo-elongatis; setis paucis; aculeis angulatis scabris rubellis demum cinereis, interioribus sub-4 validioribus compressis, exterioribus 4–8 divergentibus, extimis 6–10 gracilibus radiantibus; bacca ovata pulvillis sub-40 setosissimis stipata; seminibus erostratis.

On the Mojave, west of the great Colorado. — Joints 2½–3 or 4 inches long, attenuated below and somewhat so above; tubercles 9 lines long; inner spines 12–16 lines long, and the larger ones somewhat flattened, but less than a line wide; exterior spines 3–8 lines long, in two series. Fruit 1½ inches long. Seeds about 2 lines in diameter. — The original specimens of Dr. Parry were found farther south, near San Felipe. He describes the joints as 4–8 inches long, with shorter whitish spines or tubercles 6–12 lines long, and the flower as greenish-yellow. The Mojave plant is nearly allied to the last species, but may be distinguished by the shape of the joints, the narrower, darker-colored, more numerous spines, and the smaller and more regular seeds.

31. O. EMORYI, E. in B. C. R.; articulis cylindricis basi clavatis glaucis; tuberculis oblongo-linearibus elongatis; setis paucis; aculeis plurimis rufis, interioribus 5–9 validioribus triangulatis, compressis, exterioribus 10–20 pluriseriatis undique radiantibus; floribus flavis extus rubellis; bacca pulvillos 35–50 setosissimos inferiores aculeolatos gerentibus; seminibus valde inæqualibus irregularibus.

Arid soil, from El Paso through Sonora to the desert of the Colorado: flowers August and September. — The stoutest species of this section. Joints 4–6 inches long, curved, 1–1½ inches in diameter; tubercles 1–1½ inches long; longest spines 1½–2½ inches long, ¾–1 line wide; the exterior spines gradually smaller, and less angular. Fruit 2–2½ inches long, partly armed with spines 4–8 lines long. Seeds from 2¼ to 3¼ lines in diameter. Cotyledons oblique or accumbent. [304]

32. O. SCHOTTII, E. l. c.: articulis clavatis; tuberculis elongatis; pulvillis pauci-setosis; aculeis rubellis

scaberrimis, interioribus sub-4 cruciatis, superiore triangulato, cæteris supra planis subtus convexis, latioribus; exterioribus 8–10 radiantibus gracilibus; bacca ovata pulvillos 35–40 pauci-setosos gerente; seminibus rostratis.

On the arid hills near the mouth of the San Pedro and Pecos, western Texas. — Distinguished by the broad and very rough spines, which are dirty red, — the larger ones with a white margin, — and by the smaller number of bristles both on the pulvilli of the joints and of the fruit, where they are mostly turned upwards. Joints 2 inches long; tubercles 8–9 lines long; spines 1½–2 inches long; the radiating ones only 4–9 lines long. Seeds 2 lines in diameter. Cotyledons oblique.

Dr. Gregg has collected a similar plant near San Luis Potosi, which at present I know not how to distinguish from *O. Schottii*. The spines are stout, perhaps less rough, and narrower, 12–15 in number; some of them borne on the upper margin of the pulvillus, which I have never seen in *O. Schottii*. Tubercles an inch long.

33. O. GRAHAMI, E. l. c.: radicibus fusiformibus; articulis clavatis; tuberculis oblongis; foliis ovatis cuspidatis; setis demum plurimis; aculeis gracilibus rubellis, interioribus 4–7 teretiusculis angulatisve, exterioribus 4–6 brevibus; bacca pulvillos sub-30 setosissimos gerente; seminibus erostratis.

Sandy bottoms of the Rio Grande near El Paso: flowers June. — Joints 1½–2 inches long; tubercles 6–7 lines long; leaves thicker and in proportion shorter than in most other species, nearly 2 lines long. Fruit similar to that of *O. clavata*. Seed 2½ lines in diameter or more. Cotyledons regularly incumbent.

34. O. BULBISPINA, E. l. c.: radicibus fusiformibus; articulis parvis ovatis sæpe ex apice proliferis fragilibus; tuberculis ovatis brevibus; pulvillis parce setosis; aculeis teretiusculis scabrellis basi bulbosis, interioribus 4 cruciatis, inferiore longiore, exterioribus 8–12 radiantibus.

Saltillo, Mexico. — Spreading masses with joints an inch long or less; tubercles 4–6 lines long; interior [305] spines 4–6, exterior ones 1½–3 lines long. Apparently near the South American *O. pusilla*, Salm, and perhaps belonging to the *Opuntiæ glomeratæ* rather than here. Fruit unknown.

§ 2. CYLINDRICÆ: adscendentes vel erectæ: articuli longiores, ovato-cylindrici seu elongati: textura lignos acompacta, tubum reticulatum vel truncum compactum formans: flores magni seu parvi, purpurei vel raro flavi: bacca sicca vel subcarnosa, floris rudimenta plerumque dejiciens, aculeata seu inermis.

* *Polyacanthæ:* lignum plerumque reticulato-tubulosum: articuli crassiores distincte tuberculati: aculei plures seu plurimi: flores plerumque rubri: semina immarginata.

† *Humiliores:* diffuse ramosæ: articuli subclavati: flores plerumque flavidi: baccæ siccæ, aculeatæ.

35. O. DAVISII, E. & B. in P. R. Rep.: caule dense lignoso ramosissimo divaricato; articulis junioribus erectis elongatis basi attenuatis; tuberculis oblongo-linearibus; aculeis interioribus 4–7 subtriangularibus rufis vagina straminea laxa indusiatis divergentibus; aculeis inferioribus 5–6 gracilibus; bacca ovata pulvillis sub-25 aculeigeris stipata.

On the Llano Estacado, near the upper Canadian River; common. — Spreading and somewhat procumbent, about 18 inches high; the only one in this section with dense wood. Joints 4–6 inches long, rather slender; tubercles 7–8 lines long. Interior spines 1–1½ inches in length; lower ones 3–6 lines long. Fruits (all sterile, and perhaps not properly developed) an inch or more in length.

36. O. ECHINOCARPA, E. & B. l. c.: erectiuscula; ramis numerosis patentissimis; articulis ovatis basi clavatis; tuberculis ovatis confertis; aculeis majoribus sub-4 albidis stramineo-vaginatis, 8–16 minoribus undique radiantibus; flore flavo (?); bacca globosa depressa seu hemisphærica late profundeque umbilicata pulvillis sub-40 aculeatissimis stipata; seminibus late commissuratis.

Var. β. MAJOR: elatior; articulis elongatis; aculeis longioribus laxius vaginatis paucioribus; baccis globosis pulvillos pauciores (25) gerentibus.

In the valley of the lower Colorado; β. in Sonora. — Var. α. is a low shrub, 6–18 inches high; joints [306] 1–2½ inches long; tubercles 4–5 lines long; spines not over an inch in length. Flower apparently yellow, about 1½ inches in diameter and somewhat persistent on the fruit. Fruit very shallow, saucer-shaped, with few large seeds. Var. β. is 4 or 5 feet high; joints 8–10 inches long; interior spines 1–1¾ long. Fruit globose, or even ovate, with 25 pulvilli. Seeds the same in both.

37. O. SERPENTINA, E. in Sillim. Journ. 1852: erectiuscula seu subprostrata; articulis elongatis cylindricis; tuberculis ovatis; aculeis 7–9 albido- seu rufido-vaginatis; flore flavo extus rubello; bacca subhemisphærica late et profunde umbilicata villosa aculeatissima.

Near the sea-coast about San Diego, California. — Sometimes 4–5 feet high, but often prostrate; joints 6–12 inches long; spines less than an inch long. Flower cup-shaped, 1¼ inch wide. Fruit apparently like that of the last species, but "long woolly" and with fewer pulvilli, also often crowned with the persistent flower. Seed unknown;

said to be large. — Closely allied to the foregoing species. Can this be Nuttall's *Cactus Californicus* (*Cereus*, Torr. & Gr. Fl.), with cylindric branches, yellow flower, and spiny fruit?

†† *Deciduæ:* arborescentes: articuli tumidi, perfragiles: tubercula depressa: flores purpurei: baccæ sæpissime steriles, proliferæ.

38. O. PROLIFERA, E. l. c.: ramis divaricatis; articulis ovatis seu ovato-cylindricis perviridibus versus ramorum apicem congestis; tuberculis obovato-oblongis prominulis; aculeis 8–10 obscuris stramineo- seu rufo-vaginatis, singulo centrali, cæteris patulis; flore rubro; bacca ovata aculeolata plerumque sterili prolifera.

On arid hills about San Diego, California, forming extensive thickets. — Stems 2–4, and sometimes even 6–7 inches in diameter, 3–10 feet high; joints 3–6 inches long and 1½–2 in diameter; tubercles about 6 lines long; spines 6–14 lines long, the lower ones shorter. Flowers red, salver-form, 1½ inches in diameter.

39. O. FULGIDA, E. in B. C. R.: ramis divaricatis; articulis ovatis seu ovato-cylindricis glaucescentibus versus ramorum apicem congestis; tuberculis ovato-oblongis prominulis; aculeis 5–9 subæqualibus laxe vaginatis undique stellato-porrectis; flore purpureo parvo; bacca ovata inermi vix tuberculata; seminibus parvis rostratis.

Mountains of western Sonora: flowers July and August. — Plant 5–12 feet high; joints 3–8 inches long; tubercles rather elongated, 6–7 lines long; spines 1–1¼ inches long, hiding the whole plant with their [307] lustrous sheaths. Flower about an inch or less in diameter. Fruit fleshy, 1–1¼ inches long, usually sterile. Seeds smaller than in any other Opuntia examined, 1–1½ lines long.

40. O. BIGELOVII, E. in P. R. R.: ramis erectis adscendentibusve; articulis ovato-cylindricis pallide virescentibus congestis; tuberculis subhemisphæricis depressis confertis; aculeis 6–10 robustioribus et totidem gracilioribus inferioribus; ovario tuberculato; bacca tuberculata subinde (sterili?) aculeolata; seminibus parvis.

On Williams's River, of the Californian Colorado. — Stem 3–4 inches thick and 10–12 feet high, the branches forming a dense contracted head, with joints 2–6 inches long; tubercles 3–4 lines long; larger spines about an inch long, smaller ones 4–7 lines long.

The three foregoing species represent this subsection west of the California mountains, and east of them both south of the Gila and north of it, and seem to be well distinguished from one another by the characters indicated.

††† *Cristatæ:* frutescentes vel arborescentes: articuli cylindrici: tubercula plerumque cristata prominula: flores purpurei: baccæ inermes seu rarius aculeatæ.

41. O. WHIPPLEI, E. & B. in P. R. R.: caule erecto seu rarius subprocumbente divaricato-ramoso; articulis cylindricis; tuberculis ovatis confertis; aculeis brevibus cinereo- seu stramineo-vaginatis, 1–4 majoribus, 2–8 brevioribus deflexis vel radiantibus; flore rubro; bacca subglobosa tuberculata flava inermi; seminibus regularibus.

Var. *α.* LÆVIOR: humilior, aculeis paucis deflexis.

Var. *β.* SPINOSIOR: elatior, aculeis plurimis radiantibus.

From Zuni westward to Williams's River (*α.*), and south of the Gila (*β.*): flowers in June. — The first state is from a few inches to 3–6 feet high; the second forms small trees 8–10 feet high. Joints ½–¾ inch in diameter; tubercles about 5 lines long; spines very variable, between 3 and 9 lines long. Flower (of var. *β.*) 1¼–1½ inches in diameter. Fruit about an inch long.

42. O. ARBORESCENS, E. in Wisliz. Rep. (*O. stellata*, Salm): arborescens; ramis verticillatis horizontalibus vel pendulis; articulis verticillatis cylindricis; tuberculis cristatis prominentibus; aculeis 8–30 stellato-divaricatis; flore purpureo magno; bacca subhemisphærica tuberculato-cristata flava inermi; seminibus regularibus.

From north and east of Santa Fé and the Llano Estacado, to Zuni; extending southward deep into [308] Mexico: flowers May–July. — Northward 5–6, south 10–20 or more feet high; easily characterized by the horizontal and verticillate branches, etc.

43. O. ACANTHOCARPA, E. & B. in P. R. R.: arborescens; ramis alternis adscendentibus; articulis cylindricis; tuberculis elongatis; aculeis 8–25 stellato-divaricatis; bacca subglobosa tuberculata aculeata; seminibus multangulatis.

Mountains of Cactus Pass, between Santa Fé and the western Colorado. — Stems 5–6 feet high; branches few, alternate, and separating from the stem at an acute angle. Joints (as in the preceding) 4–6 or 8 inches long, about an inch in diameter; tubercles 9–10 lines long; interior spines 1–1¼ inches, exterior ones 4–10 lines long. Spines of fruit on the depressed tubercles 3–6 lines long. Seeds large, unlike those of any other Opuntia seen by me.

44. O. MAMILLATA, A. Schott in litt., B. C. R.: arborescens, divaricato-ramosissima; articulis crassis abbreviatis perviridibus; tuberculis tumidis; aculeis 4–6 brevibus plerisque deflexis; flore parvo purpureo; bacca obovata inermi; seminibus parvis.

Sonora, on the Sierra Babuquibari, in fertile soil: flowers July and August. — Stems 5–6 feet high; joints 3–4 inches long, 1½ inches in diameter; the swelling tubercles very prominent; spines 3–9 lines long, sometimes almost wanting. Flowers an inch or less in diameter.

45. O. THURBERI, E. in B. C. R.: frutescens, erecta; articulis cylindricis gracilibus elongato-tuberculatis; aculeis 3–5 brevibus divergento-deflexis; flore miniato.

Bacuachi, Sonora: flowers June. — Much more slender than any species yet enumerated in this subgenus. Joints half an inch in diameter; tubercles 9 lines long; spines 3–8 lines long, the lowest one the stoutest. Flower 1½ inch in diameter.

* * *Monacanthæ:* lignum densum: articuli graciliores obscure tuberculati: aculei singuli: flores flavi seu rubri: semina plus minus marginata.

46. O. WRIGHTII, E. l. c.: frutescens, erecta; articulis cylindricis gracilibus elongato-subtuberculatis; aculeis subsingulis porrectis vel subdeflexis; flore miniato.

On steep mountain-sides, from the Limpio to the Pecos, and in northern Mexico: flowers June and July. — Shrub 2–4 feet high, 1–1½ inches thick. Joints 4 lines in diameter; tubercles depressed, 7–9 lines [309] long; spines 8–10 lines long. Flower about 1–1¼ inches in diameter.

47. O. ARBUSCULA, E. l. c.: arborescens, erecta, capitato-ramosissima; articulis læte viridibus elongato-subtuberculatis; aculeis subsingulis porrectis vel subdeflexis; flore flavo-virescente.

On the lower Gila, near Maricopa village: flowers June. — A truly arborescent form, with a solid trunk of 4 or 5 inches in diameter, 7–8 feet high; joints 2–3 inches long, about 4 lines in diameter; tubercles indistinct, about 6 lines long; spine 9–12 lines long, often with 1 or 2 smaller ones under it. Flower 1½ inches in diameter.

48. O. VAGINATA, E. in Wisliz. Rep. (partim): frutescens, erecta; ramis erectiusculis; articulis subtuberculatis; aculeis subsingulis; bacca obovata tuberculata coccinea.

Albuquerque, New Mexico, and southward. — Shrub 3–5 feet high, 1–1½ inches thick; joints 3–4 lines in diameter; tubercles rather distinct, 6–9 lines long. Fruit 8–9 lines long. Seed about 2 lines in diameter. Perhaps a stout form of the next species.

49. O. FRUTESCENS, E. in Plant. Lindh. 1845: frutescens, erecta; ramis erectiusculis; articulis teretibus; aculeis subsingulis; flore parvo virescente; bacca obovata haud tuberculata coccinea.

Var. *α.* LONGISPINA: articulis nascentibus stipitatis; aculeis validioribus longioribus laxe vaginatis.

Var. *β.* BREVISPINA: articulis nascentibus sessilibus; aculeis gracilioribus brevioribus arcte vaginatis.

From the Colorado of Texas to Matamoras and Saltillo, westward to Sonora and the Californian Colorado: flowers June to August. — Var. *α.* is the usual western form; *β.* occurs only in Texas and eastern Mexico. — Shrub 3–5 feet high, stem 1–1½ inches thick; joints 2–3 lines in diameter; indistinct tubercles 3–5 lines long; spines in *α.* 1–2 inches, in *β.* 4-6 lines long. Flower 7–9 lines in diameter. Fruit 5–9 lines long. Seeds few, usually 1½ lines in diameter.

50. O. TESSELLATA, *O. ramosissima,* E. in Sillim. Journ. 1852: frutescens, erecta seu diffusa, divaricato-ramosissima; articulis gracilibus tessellato-tuberculatis cæsiis; tuberculis 5–6 angulatis planis inermibus seu aculeum elongatum paucosque minutos gerentibus; flore purpurascente parva; bacca setosissima sicca.

Valley of the lower Colorado from Sonora to the California mountains: flowers May to September. — [310] Stems 2–6 feet high, at the base 1–3 inches thick; joints 3–3½ lines in diameter, ashy gray; the singular flattened and angular tubercles 2½–3 lines long; spines 1½–2 inches long, crowded together at the upper end of each year's growth, very loosely sheathed. Flower purple, half an inch in diameter. Fruit 9–10 lines long, covered with reddish-brown bristles. Seed 2 lines or less in diameter.

*** The material for the present study of our *Cactaceæ* is not as full as would have been desirable in the examination of so difficult a family. Hence it may sometimes have happened that what I have endeavored to distinguish as species are forms which properly belong together; or I may have combined as one species incomplete specimens of quite distinct plants. The fear of confusing heterogeneous plants under one name, and the desire to indicate to future explorers all the different forms known to me, combined to induce me to proceed as I have done.

For those who naturally may be horrified at the idea of 117 species of *Cactaceæ* in a territory where a few years ago scarcely half a dozen were known, I will indicate how the mass of material may be comprehended under fewer types.

Of *Mamillariæ* the species 1–9 are quite distinct, and can in no manner be united; 10–12 might perhaps be considered as forms of a single species; 13–17 are all very distinct; 18 and 19, 20–23, 25 and 26, 27 and 28 may possibly be forms of only 4 types, instead of 10, as I have enumerated them, — thus referring my 30 species to 22 types.

In the genus *Echinocactus* the following species might be united: 1 and 2, 7 and 8, 9 and 10, 12 and 13, 14 and 15, — leaving 15 instead of 20 types.

The following species of *Cereus* will perhaps bear reduction: Nos. 1 and 2, 3 and 4, 5–7, 10 and 11, 12–14, 16 and 17, 18–22 (though some of them, of which I do not even know the flowers, may prove to belong even to different sections!), 23 and 24, — thus reducing my 31 species to 18 types.

Opuntia is a still more difficult genus, and mistakes are here most easily made. Many of them are as yet very incompletely known; and without being able to compare a great number of living specimens in their native state and in all stages of development, it can hardly be [311] expected that any one should know beforehand what constitutes the specific characters in these plants. I have tried to unite the forms which seemed to justify such a proceeding (see, e. g., *O. Rafinesquii*, here made to comprise quite a suite of forms as subspecies). Still it may be thought that a greater reduction was yet desirable; but with our present data this would involve great danger of jumbling heterogeneous materials together. Nos. 5 and 7 (of which latter neither flower nor fruit is known) can perhaps be united; also 9 and 10, 11 and 12, 13 and 14, 16 and 17, 19 and 20, 22–24, 25–28, 29 and 30, 31–33, 35–37, 38–40, and 48 and 49, — leaving 31 types, 29 of which are indigenous to our territory, and two cultivated.

GEOGRAPHY OF THE CACTUS REGION OF THE UNITED STATES.

The localities where our Cacti grow are so little known to those who have not made the geography of the West a particular study, or are not familiar with the publications of our Western explorers, that it seems necessary to add a few explanatory remarks.

Texas, as at present organized, is bounded southeasterly by the Gulf of Mexico, into which the following rivers mentioned in the foregoing pages empty, following the order from east to west: the Brazos, the Colorado with the Llano, the Guadalupe with the Pierdenales and San Antonio, the Nueces, and the Rio Grande. The latter forms the southern and southwestern boundary as high up as El Paso. On it are the towns of Matamoras (not far from its mouth), Mier, Laredo, and (higher up) Presidio del Rio Grande; then Fort Duncan or Eagle Pass (southwest of which is Santa Rosa, in the State of Coahuila). Next comes the mouth of the San Pedro or Devil's River (a small river, or rather torrent, running southward); and not far from it the mouth of the Pecos or Puerco, which rises at the north-northwest in the upper parts of New Mexico. Between the mouth of the Pecos and El Paso we notice only Presidio del Norte, San Elizario, and a "cañon" below the latter. The valley of the Limpio — a little more to the northward, between the Pecos and El Paso — is a remarkable locality; probably because there porphyritic rocks take the place of the cretaceous formation of the more eastern districts.

Chihuahua is the well-known capital of the Mexican State of the same name, south of El Paso.

The Canadian River is a southern tributary of the Arkansas, running eastwardly very [312] nearly under the 35th degree of latitude, and bounding on the north the elevated plains known as the Llano Estacado, in the northwestern parts of Texas and the adjoining regions of New Mexico.

The upper Rio Grande runs through New Mexico from north to south. The capital, Santa Fé, is not far from the river, in lat. 35½°; and the town of Albuquerque is a little below. Doñana is a small place on the river, above El Paso. El Paso itself, where the Rio Grande breaks through the mountain ranges, changing its heretofore southern to a southeastern course, is the central point of our Cactus region, partly from its geographical position, and partly because many of our explorers have made it the centre of their operations.

The present southwestern boundary of the United States runs from El Paso irregularly westward through the former Mexican State of Sonora to the Colorado "of the West," or "of California," which comes from the South Pass in the Rocky Mountains, and runs southwestward and southwardly. Its principal tributaries rise in the east. Those most important to us are the Little Colorado, or Colorado Chiquito, under the 35th and 36th degrees of latitude; Bill Williams's Fork, or Williams's River, as it is lately styled, farther south; and in lat. 33° the Gila River, which rises near the "Copper-mines," northwest of El Paso.

Proceeding from Santa Fé westward, we find the Indian town of Zuni, on the head-waters of the Little Colorado; then the San Francisco mountains, the Cactus Pass at the head of Williams's River, and this stream itself. All this territory is at present included in the political organization of New Mexico, though uninhabited by whites.

West of the Colorado, in lat. 35°, is the Mojave or Mohave River, rising in the Sierra Nevada near the Cajon Pass. Lower down, opposite the mouth of the Gila, the country is a sandy desert, extending westward nearly to San Felipe, on the eastern slope of the California Mountains in the same latitude. On the western sea-coast the town of San Diego is the only interesting point for the plants under review.

GEOGRAPHICAL DISTRIBUTION OF THE CACTACEÆ IN THE TERRITORY OF THE UNITED STATES.

As to the geographical distribution of the *Cactaceæ*, our territory may properly be divided into eight regions, namely: —

1. The Atlantic Region, which has only a single *Opuntia*, and that peculiar to it. [313] Along the southern coast some West Indian species may yet be expected.

2. The Mississippi Region, including the Western States, produces another *Opuntia*, which, in different distinct forms, extends into the third, fourth, and fifth regions.

3. The Missouri Region; namely, the Northwestern or Upper Missouri Territory to the Rocky Mountains. It furnishes two *Mamillariæ* of the subgenus *Coryphantha*, both extending into the fourth and fifth region; and three *Opuntiæ*, one of which only is peculiar.

4. The Texan Region; namely, the eastern and inhabited parts of Texas, westward to the San Pedro, and northward including the territory south of the Arkansas River. This region produces five *Mamillariæ*, two of them peculiar to this district: three *Echinocacti*, none of which are found in any other of our regions:[1] six *Cerei* (five *Echinocerei* and one *Eucereus*), all of them peculiar to this district: and six *Opuntiæ*, of which only three are restricted to it; among them is only a single cylindric *Opuntia*. This region contains therefore altogether twenty species, fourteen of which are peculiar to it.

5. The New Mexican Region; namely, western, uninhabited mountainous Texas, and eastern New Mexico to the eastern head-waters of the Colorado of California. This region is our richest Cactus district. It has furnished sixty-five species, fifty-five of which are peculiar to it, namely: nineteen *Mamillariæ* (eight *Eumamillariæ*, ten *Coryphanthæ*, and one *Anhalonium*), of which sixteen are peculiar: nine *Echinocacti*, all of them belonging to this district only: sixteen

[1] Always excepting Mexico itself, south of the Rio Grande, into which many, if not most, of our species extend.

Cerei (fifteen *Echinocerei*, fourteen of which are peculiar, and one *Eucereus*, common also to other regions): and twenty-two *Opuntiæ;* of these twelve are flat-jointed, four clavate, and five cylindrical ones; seventeen of these species are peculiar.

6. The Gila Region, comprising the whole valley of the Colorado south of lat. 36°, [314] and the country of the Gila, its large southern tributary. This has thus far furnished thirty-six Cactaceæ, namely: five *Mamillariæ*, three of them peculiar species: six *Echinocacti*, none of them found elsewhere: seven *Cerei*, representatives of each of our four subgenera, and five of them peculiar: eighteen *Opuntiæ*, of which six (all peculiar) belong to the *Platopuntiæ*, two to the clavate and ten to the cylindric *Cylindropuntiæ;* one of the former and nine of the latter peculiar.

7. The Californian Region — namely, California west of the Sierra Nevada, and comprising the southwestern part of the present State of California — produces six *Cactaceæ*, five of which are peculiar. They are one *Mamillaria:* one *Echinocactus:* one *Cereus* of the section *Eucereus:* and three *Opuntiæ*, one of them a *Platopuntia*, — probably only a form of a more eastern species, — and two peculiar *Cylindropuntiæ*.

8. The Northwestern Region, comprising the northern parts of the State of California, the Territories of Utah, Oregon, and Washington. This region has so far furnished only a single *Opuntia* (from eastern Oregon), common also to the Missouri region. — Mr. Geyer, in his account of his expedition to Oregon in 1843, mentions two *Mamillariæ* and a "*Melocactus*" (?), which latter he has not seen himself, nor are there any known specimens in existence.

CORRECTIONS AND ADDITIONS.

Page 267 = 131. *Mamillaria scolymoides* has been collected by Mr. Wright, on the Pecos, in western Texas.

Page 286 = 139. *Cereus Berlandieri* is very near *C. pentalophus*, DC., but Prince Salm, who has cultivated both side by side, considers them well distinguished.

Page 300 = 146. *Opuntia Missouriensis* has been sent from Clear Water, on the Kooskooskie, in Oregon, by the Rev. Mr. Spalding.

CORRECTIONS AND ADDITIONS TO THE SYNOPSIS OF THE CACTACEÆ OF THE UNITED STATES.

On p. 279 = 136 the var. *minor* of *Cereus dasyacanthus* should be cancelled, and after *C. longisetus*, [345] p. 280 = 137, the following added: —

9½. C. Rœtteri, E. in B. C. R.: ovato-cylindricus, 10–12-costatus; areolis ovato-orbiculatis; aculeis e basi bulbosa subulatis-rubellis apice obscuris exterioribus 10–15, interioribus 2–5 robustioribus sub-brevioribus; [346] floribus subterminalibus magnis purpureis; bacca subglobosâ; seminibus tuberculatis.

El Paso, southward to the Sandhills: flowers April. — Stem 5–6 inches high; spines 4–8 lines long; flower 2½–3 inches long. Similar to *C. dasyacanthus*, from which it is distinguished by the fewer ribs, fewer and stouter spines, purple flowers, smaller fruit, and larger seed. This species is intermediate between the *Pectinati* and *Decalophi*.

After *Opuntia setispina*, p. 294 = 143: —

O. Pes Corvi, Le Conte, mss.: articulis parvis teretiusculis; pulvillis subconfertis setas paucas breves graciles flavidulas gerentibus plerisque armatis; aculeis binis ternisve gracilibus sæpe basi compressis tortisque; flore flavo minore.

Sandy coast of Georgia (Major Le Conte), and Florida (Dr. Chapman). — Joints not much over an inch long, and half as thick; spines 1–1½ inches long, straight and slender. Flower 1½ inches in diameter. Ovary only with 5 areolæ; stigmas 5. — In the shape of the joints this curious little species resembles *O. fragilis*, but in other respects it seems intermediate between *O. vulgaris* and *O. tenuispina*.

VII. DESCRIPTION OF THE CACTACEÆ COLLECTED ON ROUTE NEAR THE THIRTY-FIFTH PARALLEL, EXPLORED BY LIEUTENANT A. W. WHIPPLE IN 1853, 1854. — By Drs. Engelmann and Bigelow.

From Reports of Explorations and Surveys for a Railroad from the Mississippi River to the Pacific Ocean. Vol. IV. 1856.

MAMILLARIA, Haw.

I. Eumamillaria. Engelm. in Synops. Cact.

1. Mam. Wrightii, Engelm. in Rep. of Bound. Com.: Flowers and fruit were unknown until specimens [27] brought from the Pecos flowered in Washington. From these the following description was drawn: —

"Sepalis exterioribus triangularibus obtusiusculis fimbriatis sub-13, interioribus margine petaloideis acutis sub-8, petalis (purpureis) lanceolatis acuminatis aristatis sub-12; bacca succosa majuscula purpurascente floris rudimentis coronata; seminibus obovatis basi acutis scrobiculatis nigris. (Pl. I.) I am not certain whether the flower is actually lateral and the germen immersed; whether, therefore, this species actually belongs to the true *Mamillariæ* or to the subgenus *Coryphantha*. I am, on the contrary, inclined to consider at least the germen immersed. I nevertheless think it best to leave this species with the *Crinitæ* — to which it seems to be so nearly allied — till more complete observations establish the contrary. The flower is about one inch long, petals and margin of inner sepals bright purple; berry large and purplish; seeds about 0.7 line long."

High plains near the Gallinas. Hills and rocky places near Anton Chico, on the Pecos, Sept. 25, 1853. Santa Rita del Cobre mountains; near Lake Santa Maria, Chihuahua. Wright and Bigelow, in boundary collections.

2. M. Grahami, Engelm. in Rep. Bound. Com. Sand and gravelly banks of streams. Williams's River to the Colorado Grande, Jan. 26, 1854.

3. M. phellosperma, Engelm. in Synops. Cact. (*M. tetrancistra*, Engelm. in Sillim. Journ., November, 1852): Living specimens of this and the preceding species have been brought to Washington, and are now growing in the Congressional Garden. Few specimens only show more than one of the four central spines hooked. The manifestly improper name previously adopted had therefore to be altered. "I have substituted for it a name derived from the peculiar spongy or corky appendage of the seed, which greatly resembles that of the seed of *Potentilla paradora Nutt.*" — (Engelmann). Sandy banks of streams, Colorado Grande and Mohave, Feb. 4–23, 1854. The external habit of this plant very much resembles that of *M. Grahami*, and was collected in nearly the same localities.

4. M. meiacantha, Engelm. in Rep. Bound. Com.: Distinguished from *M. applanata* by the fewer and stouter spines; central spine often wanting. Cedar plains near the Llano Estacado to the Pecos, Sept. 23–27, 1853.

II. Coryphantha. Engelm. Synops. Cact.

5. M. Nuttallii, Engelm.: var. γ. *robustior* aculeis lævioribus radialibus sub-12, centrali robusto. The [28] northern and Texas plants have pubescent spines.

Plains on the False Washita and Canadian, near Fort Arbuckle, Aug. 22–29, 1853.

6. M. vivipara, Haw.

β. Neo-Mexicana, Engelm. in Rep. Bound. Com. Found in many different forms, from the plains of the Canadian, in longitude 100°, to the Aztec mountains in longitude 112° west. The forms mostly belong to the var. β. *Neo-Mexicana*. One of the specimens brought to Washington bore abnormal flowers, quite interesting in a morphological point of view. The ovary is 4–5 lines long, covered with 8–12 fimbriate sepals (or scales), much like the ovary of an *Echinocactus*, the ovules deformed or wanting; styles irregularly divided to the base, or nearly so, in 8–10 parts, stigmatose at the upper part; other parts of the flower normal. This plant occurs in the greatest variety of altitudes through 12° of longitude. Specimens of it were collected on the top of the Sandia mountains, near Albuquerque, upwards of 13,000 feet above the level of the sea, Sept. 4, 1853, to Jan. 17, 1854.

ECHINOCACTUS, Link.

No specimen of this genus was found till the Colorado Chiquito was reached. From there to the California mountains five species were observed, two only of which — *E. Lecontii* and *E. Emoryi* — had before been seen anywhere else.

1. **E. Whipplei, sp. nov.: globoso-ovatus, costis 13–15 (sæpe obliquis) interruptis tuberculatis, areolis orbiculatus approximatis; aculeis radialibus compressis albidis, infra brevioribus, supra deficientibus; aculeis centralibus 4 radiales superantibus, summo complanato recto albido, ceteris plerumque longiore compresso-quadrangulatis fusco-atris demum cinereo-rubellis, 2 lateralibus rectis sursum divergentibus, inferiore robustiore deorsum hamato; flore? bacca? seminibus oblique obovatis opacis minutim verrucoso-tuberculatis. (Plate I.)**

This species was discovered on Lithodendron Creek, near the Colorado Chiquito, about ninety miles west of Zuñi, in sandy plains, Dec. 3–4, 1853. At first only dead specimens were found; afterwards young living ones were collected. It was not seen after leaving the valley of the Little Colorado. We have named this very pretty species in honor of Captain A. W. Whipple, the zealous and talented commander of this expedition.

Our plant is from 3 to 5 inches high, and 2 to 3 or 4 in diameter. The outer spines are straight or slightly recurved, 6–9 lines long; the lower ones shorter than the others. The two lowest lateral spines are darker, and almost form a cross with the two upper dark central spines; the five other radial spines are white. The upper central spine is the longest and broadest of all, being 12–18 lines long, and $\frac{1}{2}$ to $1\frac{1}{4}$ line broad at base, and mostly straight, and directed upwards almost contiguous with the radial spines, the circle of which it seems to complete. The three other central spines are a little shorter, 12–15 lines long, nearly equal among themselves, quadrangular compressed, often somewhat curved, dark brown or black when young, with lighter tips; afterwards reddish, and finally of an ashy color. The lowest one has a sharp recurved hook, which is whitish on the convex side of the curvature.

Among the débris of the dead specimens preserved, a number of seeds were found which no doubt belong to this species. They are large, 1.6–1.7 lines long and 1.2 lines in diameter, very little compressed at the upper part, narrowed down to an acute point below the large orbicular hilum, and sharply carinate on the lower part of the back (opposite the hilum).

E. Whipplei evidently belongs to the section *Hamati*, found in numerous forms on the middle and lower Rio Grande. With *E. polyancistrus* it is, so far as at present known, the only representative of this section west of the Rocky Mountains. It is more nearly allied to *E. brevihamatus Engelm.* from Eagle Pass, the seeds of [29] which are as yet unknown. It is, however, easily distinguished by the arrangement of the spines: the eastern species has 11 terete radial spines all around, and 4 central ones, the uppermost one being smaller and narrower than the lower hooked one.

2. **E. POLYANCISTRUS, sp. nov.: ovatus s. demum subcylindricus, costis 13–17 obtusis tuberculatis interruptis; areolis orbiculatis s. cum areola florifera contigua minore ovatis, junioribus fulvo-tomentosis; aculeis radialibus sub-19 compressis albis, summo deficiente, superioribus latioribus longioribus apice adustis, lateralibus brevioribus, inferioribus brevissimis subsetaceis; aculeis centralibus 2–3-formibus, summo singulo (rarius binis) compresso-quadrangulato elongato albo apice adusto sursum curvato, reliquis 5–10 teretiusculis s. subangulatis purpureo-fuscis, 2 superioribus plerumque rectis (rarius uncinatis) ceteris omnibus arcete uncinatis; floribus in axillis summis solitariis; sepalis sub-25 orbiculato-ovatis abrupte acuminatis mucronatis ciliatis, petalis acuminatis aristatis, stigmatibus 9–10. (Plate I. figs. 1–2.)**

On gravelly hills and sandy plains at the headwaters of the Mojave, on the eastern slope of the California Cordilleras, one day's journey before reaching the Cajon Pass. This elegant and striking species was collected March 15, 1854, with young flower-buds. The plant is 4–10 inches high and 3–4 in diameter; areolæ 4 lines in diameter and (from centre to centre) 7–9 lines distant from one another, the younger ones covered with a reddish-yellow wool. The 4 upper radial spines 1–2, lateral ones $\frac{3}{4}$–1, and lowest $\frac{1}{2}$ inches long. The upper central spine is 3–5 inches long and $\frac{1}{2}$–$\frac{3}{4}$ line wide; sometimes a second similar but smaller one is seen above or beside it. All the other central spines are bright purple-brown; the upper ones longer (2–3 or even $3\frac{1}{2}$ inches long), the others gradually shorten, the lowest not more than $1\frac{1}{4}$–$1\frac{3}{4}$ inches long. The two uppermost brown spines are often straight, but sometimes, like all the lower ones, sharply hooked, the hooks being turned in different directions; the convexity of the hook is of a paler color. In the young or smallest specimens we find only 5 brown spines, all hooked, one in the centre of the others; in others 5 to 7 or 8 brown hooked spines are counted, one central to the others, or all in a semi-circle, the upper part of the central circle always closed by the broad white spine.

The flower buds were just forming in the axils of the half-grown spines. Those glandular organs which divide the floriferous from the spiniferous areolæ in *E. setispinus*, and other species, seem to be very partially only and incompletely developed in this species.

3. **E. LECONTEI, Engelm. in Bound. Com. Rep.: ingens, ovatus s. ovato-cylindricus, costis 20–30 compressis sub-obtusis interruptis, areolis elongato-oblongis approximatis; aculeis radialibus inferioribus superioribusque robustioribus 8–10 angulatis subannulatis plus minusve recurvatis, aculeis extimis lateralibus summisque 10–15 tenuioribus setaceis flexuosis; aculeis centralibus 4 compressis carinatis annulatis 3 superioribus sursum inferiore deorsum curvatis; floribus plurimis subcentralibus, ovario squamis 30–40 reniformibus tecto, sepalis tubi oblongis 20–30, petalis 25–30 angustis sulphureis; stylo ad medium in stigmata sub-14 linearia subacuta diviso; bacca globosa**

sicca squamosa floris rudimentis coronata, seminibus oblique obovatis compressis sublucidis minutissime scrobiculatis. (Plate I. figs. 3–5.)

This gigantic species was first noticed by Dr. John L. Le Conte, on the lower Gila, where also Dr. C. C. Parry saw it. Both took it for the New Mexican *E. Wislizeni*, to which, indeed, it bears a great resemblance in habit as well as in botanical characters; but the seed that I received from the first-named gentleman at once satisfied me that I had a distinct species before me. Subsequently Dr. Bigelow met with this remarkable plant, abundantly, from the Cactus Pass, at the headwaters of Williams's River, down this stream to the Colorado, and west of it till *E. polycephalus* took its place. — (Engelmann.) It grows on rocky or gravelly plains and ravines, and often in crevices of perpendicular rocks, to the height sometimes of 5 feet, by 2 feet in diameter. The ribs are somewhat interrupted by a transverse incision between the areolæ. These areolæ in the specimen before us are 8 lines long by 4 wide, and [30] only ¼ inch distant from one another. In some specimens of *E. Wislizeni* the same closeness is observed; while in others, especially young and vigorously growing ones, they are often over 1 inch distant. The four principal central spines are 2–2½ inches long; lateral ones more quadrangular; the upper and lower ones flat and flexible, the former carinate above, the latter below. This lower one is rather the longest, and 1½–1¾ lines broad, almost straight or somewhat curved, but never (in the specimens brought home) hooked. The other spines are 1½–2 inches, the lowest are only about 1 inch long. Five radial spines are arranged below the four central ones and three to five above, three of which are often pushed into the centre by the flexuous bristly spines which occupy the space between the upper and lower radial ones and the uppermost part of the areola.

At the upper end of the areola, and between it and the floral areola, we meet with the same obtuse cylindric ligneous (when young, fleshy) glands which divide the spiniferous from the floral areolæ in several of our species of *Echinocactus*, 3–5 in number in the species before us, about 1 line long.

We had the good fortune to collect a single specimen of the fruit (the only one found), which is globose, ¾ inch in diameter, and, together with the persistent remains of the flower, about 2 inches long. Dr. Le Conte has noticed "a crown of yellow fruits on the plant, about 2 or 2½ inches long." The dissection of the dead flower indicates a structure very similar to that of *E. Wislizeni:* petals apparently fleshy and narrow; stamina numerous, very few from the base, the majority from the middle and the upper thickened end of the short tube; style 10 lines long, divided nearly down to the middle into fourteen sub-erect filiform stigmata; seed black, oblique-obovate, compressed, carinate on lower part of back, somewhat shining, and very lightly pitted (under the glass), 0.8–0.9 line long; hilum small, oval; albumen rather small; embryo ovate, straight, with short hooked cotyledons. Mr. Schott has found this species abundantly in western Sonora and the Gadsden purchase. The flowers are yellow, and similar to those of *E. Wislizeni*, but rather smaller; the stems are generally much higher and thick, and of a clavate shape; lower central spine sometimes almost hooked.

Echinocactus Wislizeni is distinguished by the less flattened, less flexible, stouter spines, the lower central one being channelled above and strongly hooked; by having only three lower radial spines, etc. The distinction indicated by the spines is confirmed by the shape and structure of the seeds; and thus the plants of the Colorado and of the Rio Grande are distinct representatives of the same type on both sides of the Rocky Mountains.

4. E. Wislizeni, Engelm. in Wisliz. Rep. (Plate III. figs. 1–2). — This plant is very abundant in the neighborhood of El Paso, where it was first found, many years ago, by Dr. Wislizenus.

The fruit and seed of this plant were collected by Captain Whipple, in the neighborhood of the *Cereus giganteus*, while engaged in surveying the Gila, on the Boundary Commission, in 1852. There possibly may be some doubt about its growing in that region, however, from the fact that Captain Whipple's fruits were labelled "*Cereus giganteus*," and were not collected by a botanist.

In our present expedition, when I first found a giant *Echinocactus* — *E. LeContei* — at Cactus Pass, I was sure, in common with Dr. Parry and Dr. Le Conte, that it was *E. Wislizeni*, which I had often seen before at Doña Ana. I was most happy, however, in being able to secure even a single specimen of the fruit and seeds of that plant, by means of which, with the spines I collected, it has been identified and confirmed by the acute observations of my friend, Dr. Engelmann. It may be well to observe here, that the figure of this plant, in Major Emory's Report, was made from a specimen seen on the headwaters of the Gila, near the mouth of the Azul branch, not far from Santa Rita del Cobre, or Copper Mines, and at least four degrees of longitude east of the place where I first met *E. LeContei*.

5. E. Emoryi, Engelm. in Emory's Report, 1848: globosus, costis 13 tuberculatis, tuberculis prominenti- [31] bus obtusis distantibus; areolis ovatis; aculeis subæqualibus robustis annulatis subcompressis recurvatis s. rectiusculis fuscis versus apicem corneis, radialibus 7 (lateralibus 6, singulo inferiore breviore) s. addito summo rarius 8; centrali singulo teretiore paulo longiore robustioreque, porrecto s. demum deflexo curvato s. subuncinato. (Plate III. fig. 3.)

Collected west of the Colorado, in the valley of the Mojave, mixed with *E. polycephalus*, and therefore not

further noted. The only specimen preserved is 9 inches in diameter, subglobose, below contracted, pear-shaped, or almost stiped.

On the lower part of the plant the areolæ are elevated on distinct ovate or subcylindric tubercles, which higher up become connected in 8 and on the upper part of the plant in 13 ribs; tubercles on this part of plant ½–¾ inch in height and diameter; areolæ 1½ inch distant, ½ inch long, a little less wide; the floral areolæ smaller, closely connected with the former, separated from it by 1–3 subglobose glandular bodies, half or mostly hidden in the tomentum. Radial spines 1½–2 inches long; the four upper lateral ones longer and stouter, the two lower ones more slender; the lowest spine the shortest (1–1½ inch long), secured like the others, or rarely hooked, similar to the shape of that spine in *E. viridescens*.

An eighth upper radial spine, similar to the others, is sometimes observed. The stouter central spine is about 2 inches long, at the point strongly recurved, or often almost hooked. Spines of a reddish-brown color, lighter horn-colored, and somewhat transparent at tip.

This is probably the plant collected and figured by Major William H. Emory, in General Kearny's expedition to California in the fall of 1846, and then named after him. We collected only one young specimen, probably on the lower Colorado, from which this description is taken. Mr. Schott has found the plant abundantly south of the Gila River, and it is known to extend to the Gulf of California. We procured a large specimen in San Francisco (said to have been brought from Guaymas), which is now flourishing in the Public Garden at Washington. This species has, when full grown, a height of 3 and a diameter of 2 feet, and 18–21 ribs. The large flowers are deep red, similar in form to those of *E. Wislizeni*.

6. E. POLYCEPHALUS, sp. nov.: globosus, demum ovatus cylindricusque, multiceps (e basi ramosus), vertice dense tomentoso, costis 13–21 acutis; areolis ovate-orbiculatis junioribus tomentosissimis; aculeis 8–12 robustissimis compressis annulatis plus minus recurvatis junioribus puberulis cinereo rubellis apice nudatis rubicundis; aculeis radialibus 4–8 infimo deficiente, superioribus si extant gracilioribus; centralibus 4 robustissimis 4-angulatis compressis, superiore latiore suberecto s. sursum curvato, inferiore longiore decurvo; floribus in vertice congestis; ovario lana nivea ex axillis sepalorum 90–100 linearum demum spinescentium orta densissime vestito, sepalis tubi infundibuliformis 100–120 lineari-lanceolati aculeato-aristatis purpurascentibus, interioribus margine petaloideis, petalis laciniato-fimbriatis herbacea-aristatis sub-30 flavis, stigmatibus 8–11 linearibus acutis; bacca globosa sicca flore coronata, lana densa involuta; seminibus magnis irregulariter angulatis minutim (sub lente) verrucosis, opacis. (Plate III. figs. 4–6.)

Stony and gravelly hills and dry beds of torrents from 20 miles west of the Rio Colorado to about 150 miles westward up the Mojave; found in fruit in the beginning of March. This distinguished species is simple only when quite young. Even the small globose plants show several heads from one base, and older cylindric stems have as many as twenty or thirty heads, all pretty nearly of the same size. The globose ones are 6–9 inches in diameter; the ovate heads are 12–15 inches high by 8–10 in diameter; and the largest cylindric stems seen were 2–2½ high by less than a foot in diameter. The number of ribs varies; in old specimens it is generally 21. Areolæ about ½ inch in diameter, and ¼–½ inch distant from one another; floral areolæ smaller, without the ligneous glandular organs noticed in others. The spines in a young 5-ribbed living specimen before us are 7 radial and 1 central one. Very soon, however, the 4 upper larger spines become central, and 4 lower spines are arranged radially. Even in old and [32] full-grown specimens sometimes not more than these 8 spines are found, the 4 upper ones (which are in this case perhaps rather improperly designated as central) stouter and cruciate, and the 4 lower ones arranged around the lower half of the areola. Generally, however, 2 upper radial spines, weaker and less curved than the 4 lower ones, make their appearance; and in a few specimens before us we find 3–4 upper radial spines, the uppermost ones being quite slender.

In the field we noted as many as 15 spines occasionally, when no doubt 7 occupy the place of upper radial ones. The central spines are always very stout, but very different in size; in some specimens we find them 1¼–1¾, while in others they are 2–3½ inches long. They are nearly straight or very much curved; the upper one is often 1½ to 2 lines wide, the lower one the longest.

The yellow flowers seem to make their appearance in February, as the fruit ripens in March. The ovary and the fruit are enveloped in dense pure white cottony wool, which originates from the axis of the lower sepals, and through which only the dark reddish-brown spinulose points of the sepals are visible. The incomplete description of the flowers was made from withered specimens adhering to the fruit. Tube of flower funnel-shaped, short and rapidly widening towards the upper end naked (without free stamina) at the lower part. Petals about 1 inch long and 2 lines wide. Style 1–1½ inch long; stigmata 4 lines long. Fruit dry, 8–10 lines in diameter, together with the remnants of the flower about 2 inches long, open at base when falling off; like the fruit of many if not most of our *Echinocacti*, seeds 2 lines long, 1½ line broad, irregularly shrivelled, appearing rugose and angular, much like those of the nearly allied *E. laticostatus* (*horizonthalonius, Lem.*). Hilum transversely oval; embryo curved, the cotyledons buried in the large albumen, accumbent, sometimes oblique.

This species is very nearly allied to *E. Parryi*, Engelm. Synops. Cact., of the neighborhood of El Paso; but this latter species is depressed globose, much smaller, simple, with only 13 ribs, whiter, less flattened spines. Fruit and seed are said to be the same, but unfortunately have been lost, and cannot be compared. No doubt, satisfactory diagnostic characters will be discovered in the seeds. The fruit of *E. horizonthalonius* and *E. Texensis* is also similar; the latter, however, though woolly, is not dry.

Very different in flower and fruit, but very similar in shape, in the many heads, numerous ribs, and stout curved annulated spines, is *E. cylindraceus*, discovered by Dr. Parry a few degrees farther south, on the eastern slope of the Sierra. We shall repeatedly have occasion, especially among the *Opuntiæ*, to indicate the remarkable analogies in the external form or in the more essential character of *Cactaceæ*, in different geographical divisions of the southwest.

CEREUS, Haw.

Subgen. Echinocereus.

1. Cereus viridiflorus, Engelm. in Wisliz. Rep., sub nom. *Echinocereus*.

On the plains east of New Mexico, near the 100th degree of longitude, to the mountains of the Rio Grande, Sept. 12, 1853.

2. C. cæspitosus, Engelm. in Plant. Lindh. l. c. The most eastern of all our *Cerei!* and only found in the plains. It was first seen about 170 miles west of Fort Smith, near the 96th degree, about the same longitude where Mr. Lindheimer first discovered it on the Brazos, four degrees farther south. Its western limit seems to be near the 100th degree, where the range of *C. viridiflorus* commences.

It may not be uninteresting to observe that this is the first time that this interesting genus has been recognized within the boundaries of the United States under the acquisition of Louisiana.

3. C. Fendleri, Engelm. in Plant. Fendl. Seen first on the high plains 50 miles east of the Pecos, about [33] the 105th degree, and extending from there over the mountains of New Mexico westward to the Aztec mountains, near the 113th degree. Southward it has been seen as far as El Paso.

The ovate or mostly elongated cylindric heads are simple or few together, and of a dark green color. They are characterized by the dark central spine, which is very bulbous and curved upwards, and by the lower radial spines being by far the stoutest, the lowest being 4-angular. Flower and fruit have been described elsewhere.

Var. β. pauperculus, with only about 6 spines, the central one assuming the place of an upper radial spine, was also found near the Pecos. It hardly deserves the designation of a distinct variety, as occasionally complete bunches of spines occur on the same plants with the depauperate ones.

4. C. Mojavensis, sp. nov.: ovatus, dense cæspitosus, 10–11-costatus, glaucescens; areolis orbiculatis junioribus dense albo-tomentosis distantibus; aculeis basi bulbosis teretiusculis s. subangulatis robustis elongatis curvatis, radialibus 7–8, infimo superioribusque debilioribus, lateralibus longioribus, centrali singulo angulato sursum incurvato. (Plate IV. fig. 8.)

Var. β.? zuniensis: dense cæspitosis 10-costatus, areolis paulo minoribus, aculeis tenuioribus basi bulbosis quadrangulatis rectis s. paulo curvatis flexuosisve, radialibus 8 infimo graciliore, summo robustiore longioreque, centrali singulo robustiore longiore recto s. sursum incurvo. (Plate IV. fig. 9.)

Found between the Rio Colorado and Mojave Creek, with *Echinocactus polycephalus* and *Opuntia erinacea*, etc., a region rich in rare *Cactaceæ*. The oval heads, 2–3 inches high and 1½–2 inches in diameter, form dense cæspitose masses much like *C. phœniceus*. The areolæ are 3 lines in diameter, 6 lines or more distant from one another. The long and very bulbous spines are curved and interlocked so as almost to hide the body of the plant. Upper and lower radial spines 9–15 lines, the uppermost one wanting or weaker than the rest; lateral spines 15–25 lines long, ashy-red when young; central spine more angled, 1½–2½ inches long, dusky; all spines ashy-gray when old.

C. Zuniensis seems to form an intermediate link between this and the next species, but resembles most the former, to which for the present, not knowing flower and fruit, we doubtfully draw it as a variety. It was found near Cañon Diablo, on the Colorado Chiquito, about 120 miles west of Zuñi. Its manner of growth and whole appearance is very much like that of the Mojave species. The spines are weaker, straighter, and more angular; the principal difference consists in the stout upper radial spine, which is similar to the central spine. Young areolæ nearly 3 lines in diameter, 4–6 lines distant. Lowest radial spine 6–9 lines, lateral ones 9–15, and upper one 12–18 lines long; central spine 1½–2 inches long, very bulbous at base. Young spines straw-colored, old ones ashy.

C. Mojavensis seems to be nearly allied to *C. Fendleri* (in both the spines are very bulbous at base, the central one single, angular, and curved upwards), but the cæspitose growth, glaucous color, longer radial spines,—the lowest one of which is weakest,—seem to distinguish it. The examination of numerous specimens *in loco*, and the flower and fruit, only can decide here whether they are distinct, or forms of a single species; and this, indeed, is the case with all

those *Cactaceæ* the fruit and flower of which are unknown to us. *C. Zuniensis* was collected Dec. 18, 1852, and the Mojave plant March 4, 1854.

5. C. GONACANTHUS, sp. nov.: ovatus, simplex s. e basi parce ramosus, costis 7 interruptis, areolis magnis orbiculatis distantibus, aculeis robustis angulatis rectis s. varie curvatis flexuosisve, radialibus 8, inferioribus lateralibusque quadrangulatis flavidis basi et sæpe apice obscuris, infimo breviore, summo elongato robusto [34] multangulo obscuro erecto aculeum centralem similem multangulatem erecto-patentem subæquante, rarius excedente. (Plate V. figs. 2–3.)

On high sand-bluffs, covered with scattering cedars, near the natural well, about 40 miles west of Zuñi, near the 109th degree; only seen in that locality. This species resembles, in its growth and the character of its species, *C. triglochidiatus*. It is simple, or has 2 or 3 heads, 3–5 inches high. The young areolæ are very tomentose, 3–4 lines in diameter, and 6–10 lines distant from one another. The lower radial spine is 8–12, the others 10–15 lines long, pale or dirty yellow when young; the upper radial spine is much stouter and longer than the others, and resembles the central spine in shape, size, and color; in the few specimens at our disposal we find it from $1\frac{1}{4}$–$2\frac{1}{2}$ inches long; sometimes it assumes a more central place in the areolæ, the two upper lateral spines almost closing above it, — very rarely a small tenth spine appears above it. The central spine is $1\frac{1}{2}$–$2\frac{1}{2}$ inches long, 1 line in diameter, deeply furrowed, and 6- or 7-angled; it is longer, equal to or rarely shorter, than the upper radial spine. Both those spines are almost black or mottled yellowish and black when young, and become, with all the others, gray when old. Collected Nov. 29, 1853.

6. C. TRIGLOCHIDIATUS, Engelm. in Wisliz. Rep., sub Echinocero. In rocky cañons at the Rio Gallinas, east of the Pecos, and from there to the Sierra Madre, near Mount Taylor; not noticed farther west; always with few branches, or nearly simple. Major Brooks, the commandant of the fort at Santa Fé, informed me that the fruit of this species is edible, like many other allied species. Collected Sept. 28, 1853.

7. C. HEXÆDRUS, sp. nov.: ovatus, simplex seu e basi parce ramosus: costis 6 obtusiusculis subinterruptis, sulcis latis superficialibus, areolis orbiculatis distantibus; aculeis tenuioribus rectis rigidis subangulatis basi bulbosis, radialibus 5–7 e flavido rubellis, inferiore breviore, summo sæpe robustiore, centrali robustiore longiore acute-angulato juniore fuscato, sæpe deficiente. (Plate V. fig. 1.)

On sandy hills, under cedars, about 15 miles west of Zuñi. Few heads, 4–6 inches high, 2–$2\frac{1}{2}$ in diameter, with 6 obtusish ribs, separated by wide and shallow grooves. Areolæ tomentose when young, only $1\frac{1}{2}$ line in diameter, 6 or 8 lines distant. Spines slender but stiff, quite bulbous at base; lower ones 5–10, upper ones 8–15 lines long; mostly 6 radial spines, without a central one, the uppermost being the stoutest, longest, and darkest one, but smaller where a central spine is present. In a single instance we found 7 radials, and in another one 2 compressed central spines; central spine usually 12–15 lines long. From the nearly allied, more southern *Cereus paucispinus*, Engelm. ined., this northwestern form is principally distinguished by the slender and angular spines. But as of neither of them we know the flower and fruit, we cannot form definite conclusions as to their specific distinction. These forms and *C. triglochidiatus* have a smaller number of ribs than any other species of this section. Collected Nov. 28, 1853.

8. C. PHŒNICEUS, Engelm. in Synop. Cact., *E. coccineus;* Engelm. in Wisliz. Rep., non De C. nec. Salm. (Plate IV. fig. 1.) Found from the upper Pecos to Albuquerque and Santa Fé; also 5 degrees further west, on the San Francisco mountains. The specimens perfectly agree with the description given in Wislizenus's Report. The numerous heads, 2–3 inches high, about 2 inches in diameter, form dense cespitose masses, often 1 foot or more across. Areolæ 3–4 lines distant, large. Spines slender, almost setaceous, with very slightly bulbous base, 8–12 radial ones 3–6, 1–3 central ones 5–10 lines long; upper radial spines much shorter than lower ones.

The following form seems very distinct, especially in its manner of growth; but we have seen intermediate forms which seem to indicate the necessity of uniting both. Such questions, however, can only be solved satisfactorily by careful examination of flower and fruit, — which are as yet unknown, — and by extensive observation of these plants in their native wilds.

9. SUBSPECIES C. CONOIDEUS: ovatus, versus apicem conoideo-acutatus, parce e basi ramosus, costis [35] 9–11 tuberculatis, areolis orbiculatis s. subovatus junioribus albo-tomentosis, aculeis basi bulbosis, radialibus 10–12 tenuibus rigidis rectiusculis, summis brevibus, lateralibus inferioribusque longioribus, centralibus 4 (rare 3–5), superioribus radiales vix superantibus infimo multo longiore 4-angulato sæpe complanato porrecto s. deflexo. (Plate IV. figs. 4–5.)

On rocky and mountainous localities on the Pecos. *Cer. Roemeri,* Muhlenpf., not Engelm., from the San Saba, in Texas, seems to agree well with our plant, but the description is not full enough to decide about the identity.

Heads 3–4 inches high, single or few, of unequal height together; remarkable on account of their conical or acutish shape uniformly observed. Areolæ 4–6 lines distant. Spines white or straw-colored, larger central one often

dusky when young; radial spines slightly bulbous at base; upper ones 2–5 lines, lateral ones 6–15 lines long, and lower ones hardly a little shorter; central spines very bulbous; upper ones not much longer than the lower radial ones; lower central spine sharply quadrangular, mostly compressed, often deflexed and curved, 1–3 inches long.

On the San Francisco mountains a specimen was collected with 11 ribs, 8–9 radial spines (4–12 lines long), the uppermost shortest, and 3–4 reddish-gray central spines, very bulbous at base, the lowest longest (12–20 lines long) and angular. In superficial appearance this plant resembles *C. Mojavensis;* but it must be referred here, and seems to indicate a range of this form through seven degrees of longitude.

A specimen from Anton Chico, on the Pecos, seems to unite *C. conoideus* with *C. phœniceus.* Areolæ more distant than the latter; spines longer; 3 central spines, lower one somewhat curved and angular. Collected Sept. 28 and Dec. 18, 1853.

10. C. ENGELMANNI, Parry, var. VARIEGATUS: ovato-cylindricus, simplex s. parce e basi ramosus, 12-costatus, areolis orbiculatis approximatis, aculeis exterioribus sub-13 gracilibus rigidis albis apice sphacelatis adpressis lateralibus longioribus, summis deficientibus; aculeis centralibus 4 cruciatis (raro 5) plus minus curvatis infimo elongato angulato albo decurvato, ceteris brevioribus teretiusculis nigris corneisque variegatis; floribus ex axillis areolarum vetustiorum inferiorum; bacca ovata sicca pulvillis numerosis setas tenues albidas plurimas gerentibus stipata; seminibus obovato-subglobosis compressis rugoso-tuberculatis opacis. (Plate V. figs. 4–7.)

Var. β.? CHRYSOCENTRUS: cylindricus, parce e basi ramosus, 10–12-costatus, areolis magnis; aculeis radialibus 12–14 albis superioribus setaceis brevibus, inferioribus longioribus robustioribus angulatis compressis rectis s. paulo incurvis, centralibus 4, superioribus rigidis robustis basi bulbosis angulatis rectiusculis elongatis, erectis vitellinis, inferiore angulato compresso albo recto paulo breviore deflexo; floribus ex inferiore plantæ parte; bacca ovata pulvillis paucis aculeos setosos longiores albos gerentibus stipata. (Plate V. figs. 8–10.)

On the Cactus mountains and at the head of Williams's River; degrees 113½ longitude. Heads 4–9 inches high, single or few, not more than 4–6 together; areolæ 2–4 lines distant. Radial spines 3–5 lines long; upper central spines 3 or sometimes 4, black on the upper and horn-colored on the lower side and towards the point, 1–1½ inches long; lower central white, 1½–2 inches long. Position of fruit on lower half of plant much like that of *C. chloranthus,* Engelm. ined., only 6–8 lines long, crowned with the remains of the (red ?) flower. Seed 0.6–0.7 line long, compressed; tubercles sometimes irregularly confluent, and leaving pits between the ridges; lower part of the back with a smooth carina; hilum oval.

Var. β. CHRYSOCENTRUS — named after its deep golden-yellow spines — is probably not specifically distinct, though the straighter, stouter, and less divergent spines give it a very peculiar appearance. It was found where *C. variegatus* disappears on the lower part of Williams's River, and was seen from there to the Mojave Creek, and up that stream to the Sierra Nevada. Stems 5–10 inches high; areolæ 6–7 lines distant, young ones 2½–3 lines in diameter. Upper radial spines 3–5, lateral 5–7, and lower ones 7–12 lines long, the latter flattened and often curved up; upper central spines 3 or sometimes 4, 2–3 inches long, bulbous and angular at base, terete [36] above; lower central spine 1½–2½ inches long, flattened. Spines on fruit 3–8 lines long, fewer and stouter than in the other form.

Cereus Engelmanni, Parry, has been found abundantly by Mr. A. Schott on the lower Gila. A specimen brought home evidently seems to unite them, and consequently *C. variegatus* and *C. chrysocentrus* are to be considered forms of it.

I am acquainted with the *habitus* of about fifteen or sixteen species of the subgenus ECHINOCEREUS. All of them are of low growth (I write of those only with which I am acquainted), never more than 12, seldom more than 8, and often less than 5 inches in height. All also are more or less cæspitose, or branching from the root; some of them slightly, others very much so. *Cereus viridiflorus, chloranthus, dasyacanthus, ctenoides, cæspitosus, longisetus, Fendleri, gonacanthus, hexædrus, paucispinus,* and *Engelmanni* grow in small irregular tufts or masses, some of the joints or stems being much taller than others. Some of them, such as *C. viridiflorus, dasyacanthus, ctenoides, cæspitosus,* and *Fendleri,* are often nearly simple, or having but few branches; while others, such as *C. chloranthus, longisetus, gonacanthus, hexædrus, paucispinus,* and *Engelmanni,* have usually 8–20 joints. *C. polyacanthus, phœniceus,* and *enneacanthus* are much branched, and grow in somewhat flattened masses, sometimes with a circular outline, but not always, all the joints being of nearly an equal height. *C. stramineus* always forms a dense hemispherical mass, of a perfectly regular contour, — the central joints being the oldest and longest, — 9–12 inches high, gradually subsiding towards the circumference of the mass until the extreme outer stems are not more than 2 inches high. *C. Mojavensis* often grows similarly, but I have also seen it in much broader masses, containing 500–800 heads or joints; in such cases it is always flattened on the top. Where this state occurs, the central joints are as high as in the hemispherical masses, but the hemispheric contour is destroyed by the longitudinal extension of the joints, forming masses sometimes 4 or 5 feet in diameter. *C. phœniceus* and *C. conoideus* — two forms which Dr. Engelmann has united into sub-species — are quite different in their manner of growth. *C. phœniceus,* as stated above, grows in irregular flattened masses, while *C. conoideus* has the more elevated and somewhat hemispherical shape of *C. stramineus.* On account of

the unfavorable season of the year (October — March) during our journey through regions of these cacti, we were unable to procure the flower or fruit of any of these plants. In our friendly correspondence with Dr. Engelmann, I insist that *C. phœniceus* and *C. conoideus* are distinct species; and (from analogy only) I assume that when the flower of *C. conoideus* is obtained, it will be found to be a *purple*, while that of *C. phœniceus* is *crimson*. Time and observation, however, are the only decisive arbiters of such controversies.

Subgen. Eucereus.

Of *Cereus* proper only one species was seen, namely:

11. Cereus giganteus, Engelm.: Williams's River to the Colorado of the west, Feb. 4 to Feb. 22, 1854. This is the most northern true *Cereus* that we have, being found as high as latitude 34°, while *C. Greggii* and *C. Emoryi* are found only a little above latitude 32°. This plant has a considerable range, extending south from this place to near latitude 28°, in the vicinity of Guaymas Sonora. The fruit under the Mexican name of *pitajaya* — pronounced pit-a-zi-ah or pit-ai-yah — is a great source of sustenance to the Mexicans and Indians of the regions where it grows. Conserves and molasses, or syrup, are made from them, which are preserved during the winter season for future use. They are very pleasant to the taste in a fresh state. As the fruit grows near the top of the tree, at an altitude of 25 to 50 feet, and being very large and pulpy, if permitted to ripen and drop to the ground they burst and are almost rendered unfit for use. The Indian mode of collecting them is to take a long light pole, make a fork at the top by tying a short piece to it, by which they contrive to bring them within reach. Birds and every kind of animal and insect that can reach them are so fond of them that many of them are thus destroyed. My friend, Mr. Schott, [37] of the Mexican Boundary, who has lately returned from that desolate but rather interesting region, informs me that still farther south this interesting plant is replaced by another not so large, but still a great cactus. This is very probably the one collected by Mr. Thurber, described and named by Dr. Engelmann, in Silliman's Journal, *C. Thurberi*. The pitajaya of this species, according to Mr. Schott, is the principal support of the Papigo Indians. It is much larger, sweeter, more juicy than that of the *C. giganteus*. The color of the pulp is also of a much brighter red.

In consequence of the remote and inhospitable region of this curious and interesting cactus, our acquaintance with it became very gradual. Dr. Engelmann thinks that Baron von Humboldt, in his work on New Spain, must have had reference to this plant; but this is quite uncertain, because no characteristics are given of his cacti (organos del Lunal) except size and edible fruit, and many other large species of both Cerei and Opuntiæ are long and well known to yield them. In 1846 Major Emory first collected seeds and made figures of it, which, on being presented to Dr. Engelmann, he was unable to pronounce it a true *Cereus*, and at that time very appropriately named it. Subsequently (winter and spring of 1852) Dr. Parry, under Major Emory, visited that region, collecting spines, wood, etc., and making copious notes on the ground, enabled Dr. Engelmann to give a good diagnosis of it. Still Dr. Parry was unable to procure the flower or fruit on account of the lateness of the season. It was reserved for Mr. Thurber, who repassed this region in the summer of 1852, to collect complete specimens; and Dr. Engelmann, in a subsequent number of Silliman's Journal, has given a complete description of it. (*Vide* Amer. Journ. Vol. XVII. 2d Series, March, 1854.)

To the several excellent accounts given of this tree by Dr. Engelmann, little of interest can be added. As noticed by Dr. Parry and Dr. Engelmann, the number of ribs at the base is about 12, and they "increase upward, by bifurcation and addition," to the largest circumference of the tree, which is about 15–18 feet from the ground, and where also usually the few branches are given off. Here the ribs sometimes number 30, and from this point upward they decrease in number to 18–20. The wood at the base of old specimens becomes a perfect hollow cylinder; and from thence upward to the first branches, instead of being solid, it becomes a reticulated network of bundles of wood continuing the hollow cylinder, as is seen on a smaller scale in the wood of *Opuntia arborescens*. These trees in abundance give the landscape a very peculiar appearance, and from their novelty and entire dissimilarity to any others, at first is not only curious but pleasing; but as the eye becomes accustomed to it, a gradual transition takes place in one's feelings, and from being pleasing, they at last become monotonous and repulsive. This feeling, however, may be somewhat accounted for by the sterility of the surrounding land. As far as the eye can reach, in the valleys or on the mountains, little else but rocky boulders, and the stately yet awfully sombre aspect of the *Cereus giganteus*, can be seen.

OPUNTIA, Tourn.

Subgenus 1. Platopuntia, Engelm.

1. Opuntia Engelmanni, Salm. At Delaware, about 170 miles west of Fort Smith, a specimen of this plant was observed about 4 feet high. This seems to be the northern limit of a species which is widely spread from lower Mexico to the mouth of the Rio Grande, and on both sides of that river, northward and southward. In the southern regions it grows much taller than in the north.

2. O. ENGELMANNI, β. ? CYCLODES: erecta, articulis orbiculatis, pulvillis remotis tomento griseo setisque stramineis rigidis inæqualibus instructis; aculeis subsingulis rectis validis compressis stramineis basi fuscis deflexis, adjectis sæpe 1–2 inferioribus brevioribus pallidioribus; bacca globosa late umbilicata, seminibus late undulato-marginatis. (Plate VIII. fig. 1.)

About the mouth of the Gallinas, into the Pecos, near Anton Chico, New Mexico; collected in fruit in [38] September. Plant 4 feet high; joints orbicular, or even transversely oval, about 7 inches in diameter; pulvilli 1 inch apart, large, with a semicircle of large, coarse bristles, 3–4 lines long at the upper edge, and a single stout spine, $1\frac{1}{4}$–$1\frac{3}{4}$ inch long, on the upper pulvilli, often with 1 or 2 additional ones, 4–9 lines in length. Flower not seen. Fruit globose, 1–$1\frac{1}{4}$ inch in diameter, of a purple color. Seed 2.0–2.3 lines in diameter, with a broad and thick acutish undulate rim. The circular joints with fewer spines, and the small globose fruit with large seeds, distinguish this form from *O. Engelmanni*, as it usually appears farther south.

3. O. OCCIDENTALIS, sp. nov.: erecta patulo-ramosissima, caule demum lignoso tereti corticato, articulis grandibus obovatis rhomboideisve, pulvillis remotis griseo-tomentosis, setis flavis s. flavo-fuscis gracilibus confertis, aculeis 1–3 validis compressis angulatis rectis deflexis divergentibusve, uno alterove ad articuli marginem superiorem erecto, albidis corneisve subannulatis basi flavo-fuscis cum adventitiis 1–2 gracilioribus pallidioribus deflexis; flore flavo intus aurantiaco, ovario obovato pulvillis fusco-villosis vix fulvo-setosis sub-25 notato subinde parce aculeolato, sepalis (extus rubellis) 10–12 dilatato-obovatis cuspidatis, petalis (8?) obovatis obtusis subintegris; bacca obovata late umbilicata succosa, seminibus majoribus irregularibus undulato-marginatis, crenulatis. (Plate VII. figs. 1–2.)

On the western slope of the California mountains, from Quiqual Gungo, east of Los Angeles, to San Pasquale and San Isabel, northeast of San Diego (A. Schott), at an elevation of 1,000 to 2,000 feet, in immense patches often as large as half an acre. Flowers in June. Stout ligneous stems, with innumerable branches, sometimes over 100 joints, spreading far, and then often bent to the ground; joints 9–12 inches long, 6–8 inches wide; pulvilli $1\frac{1}{2}$–2 inches distant, with slender and closely set (much more so than in *O. Engelmanni*) bristles, only 2–3 lines long on the upper part of the pulvillis; spines 1–$1\frac{1}{4}$, smaller ones $\frac{1}{2}$–$\frac{3}{4}$ inch long. Flower yellowish and orange, deeper colored inside at the base, 3–$3\frac{1}{2}$ inches in diameter; ovary $1\frac{1}{2}$ inch long, not 1 inch in diameter, pulvilli pretty equally distributed over it (not as much congregated toward the top as in *O. Engelmanni*); sepals short and unusually broad; petals only 9 or 10 lines wide by 15 lines in length, rounded, and not emarginate in my specimen, nor mucronate. Fruit 2 inches long, $1\frac{1}{4}$–$1\frac{1}{2}$ inches in diameter, "very juicy, but of a sour and disagreeable taste." Seeds $2\frac{1}{2}$–$2\frac{3}{4}$ lines in diameter. The young plants, raised from the seeds which we brought home, fail to exhibit the very hairy pulvilli which all the young of *O. Engelmanni* show; they bear only the numerous bristly spines seen in most young *Opuntiæ*, at least of this section.

To Mr. A. Schott, who has considerably enriched our knowledge of the vegetation of the countries along the boundary line and in the Gadsden purchase, is due the credit of having discovered the flower of this plant, heretofore unknown, and of many valuable notes about its general habits.

The plant mentioned in Silliman's Journal, November, 1852 (Dr. Parry's collections), as being common "on the hill-sides and plains near San Diego," and which Mr. Schott seems to have also found "on the sea-beach near San Diego," may be a form of *O. Engelmanni*, as suggested in the above publication; or it may be a naturalized wild state of *O. Tuni*, which is cultivated about the missions there. Enough material has not been obtained to decide about it. At all events, it seems to be distinct from the plant of the western mountain slopes.

4. O. CHLOROTICA, sp. nov.: erecta, grandis, caule demum-lignoso terete, cortice cinereo-fulvo aculeis flavis numerosissimis fasciculatis armato; articulis orbiculato-obovatis magnis pallide flavo-virescentibus s. subglaucis; pulvillis subremotis griseo-tomentosis, setis stramineis difformibus exterioribus brevioribus tenuioribus subæqualibus confertis, interioribus, uniseriatis robustioribus longioribus; aculeis in pulvillis inferioribus 1–3, in superioribus 3–6 inæqualibus stramineis plus minus compressis (nec acute angulatis) plerisque deflexis, interiore breviore subinde erecto; flore flavo, ovario tubercula pulvilli-gera conferta sub-50 gerente; sepalis tubi sub-20 oblanceo- [39] latis cuspidatis, petalis sub-10 obovato spathulatis, obtusis mucronatis, stigmatibus 8 patulis; bacca obovata tuberculosa profunde umbilicata. (Plate VI. figs. 1–3.)

On both sides of the Colorado, from the San Francisco mountains to the headwaters Williams's River — sometimes called "Bill Williams's Fork" — and to the Mojave Creek. The only erect, flat-jointed *Opuntia* in this section of country, 4–5 and sometimes even 7 feet high, forming large bushes, on one of which upwards of 100 joints were counted. The large trunks have a scaly, grayish, or light-red brown bark; the pulvilli are not obliterated on it, as they are on *O. Engelmanni*, but are largely developed, 4–6 lines in diameter, pulvinate, densely covered with a thick brown tomentum, surrounded by numberless straw-colored bristles, 4 lines in length, and bearing 20–30 or more yellow compressed spines, often 1–2 inches in length, stellately radiating in every direction, and covering and shielding the whole surface of the stem. The only *Opuntia* which I find described as having a similarly armed stem is *O. Karwinskiana*, Salm, which is said to have 18–20 gray spines on the oldest pulvilli.

Joints 8–10 inches long by 6–8 wide, always of a very pale glaucous, or rather more yellowish-green color, which is strikingly characteristic, even at a distance, and which has procured our name for the plant; pulvilli about 1 inch apart, strongly pulvinate. Bristles twofold and distinct, the upper and outer, and by far the most numerous ones are shorter and thinner, and cover the upper semi-lunar area of the areola; inside of them is a semicircular row of stouter and longer bristles, 4–6 lines long, which unite with the outer and shorter spines of the outer and lower margin of the areola. This arrangement is most distinct on the upper and more fully developed pulvilli; among our *Opuntiæ* it is only seen again, as far as known, in the obscure *O. dulcis* from Presidio del Norte. Spines proper 1–1½ inches long, pale straw color, with faint transverse markings, hardly darker at base; shorter spines 4–9 lines long.

The description of the flower was drawn from an old withered specimen gathered in winter. It seems pale yellow, between 2 and 3 inches in diameter; sepals and petals remarkably narrow, the latter about 1 inch long, and not half as wide. The ovary and fruit (all the specimens found were sterile) are quite tuberculous; pulvilli crowded, bearing brown wool and short yellow bristles. Specimens of sterile fruit seen 1¼–1½ inches long.

5. O. PROCUMBENS, sp. nov.: prostrata, articulis orbiculato-obovatis grandibus pallide viridibus, pulvillis remotissimus griseo-tomentosis, setis flavis robustis valde inæqualibus, aculeis validis 2–4 subinde (in articulis vetustioribus ?) 7–9 compressis angulatis inæqualibus, stramineis s. pallidioribus versus basin obscurioribus, sæpe rufis fuscisve, deflexis. (Plate VII. figs. 4–5.)

From the San Francisco mountains to the Cactus Pass, at the head of Williams's River, in rocky localities. Joints 9–13 inches long, 7–9 broad, prostrate, always on edge; pulvilli 1½–2 inches apart; bristles 2–4 lines long, comparatively stout; spines 1–2 inches long. No flower or fruit seen. Very similar to *O. Engelmanni*, but prostrate, with even more distinct pulvilli, and stouter and often more numerous spines.

6. O. ANGUSTATA, E. & B.: prostrata s. adscendens, articulis elongato-obovatis versus basin sensim angustatis suberectis; pulvillis remotis griseo-tomentosis, setis fulvis gracilibus; aculeis paucis (2–3) validis compressis albidis s. stramineis, versus basin rufis s. fulvis, adjectis sæpe infra 1–2 debilioribus omnibus deflexis; bacca obovata, tuberculata rubella, late profundeque umbilicata pulvillis 24 stipata seminibus magnis subregularibus late marginatis. (Plate VII. figs. 3–4.)

From the foot of the Inscription Rock, near Zuñi, to Williams's River, and westward as far as the Cajon Pass of the California mountains. Prostrate in the first and last mentioned localities, but sub-erect in the bottoms of Williams's River. Joints 6–10 inches long, and at the upper third 3–4 inches wide, gradually narrowed downwards, rounded above; pulvilli over 1 inch apart, oblong, quite strongly pulvinate, 3 lines long, bearing [40] slender brown bristles; spines in the specimens collected east of the Colorado sharply angular, pale straw-colored or whitish, brownish only at the very base, 1–1½ inch long; sterile fruit obovate-subglobose, 1–1¼ inch long, with large pulvilli crowded toward the upper end of the fruit, covered with grayish-brown wool and bright brown bristles. The specimen from Cajon Pass has brighter colored spines, with the lower half red-brown, not so angular; some erect spines, at the upper end of the joint, almost terete. On this specimen a ripe fruit was collected, from which the above description has been taken. It is 1½ inch long, nearly 1 inch in diameter, with the wide and flat umbilicus immersed about half an inch; pulvilli on tubercular elevations about 14 on the upper part of the fruit and 10 along the rim; seeds 3 lines or more in diameter, much compressed, with the broad rim almost curled. Some of the seeds have germinated, and the young plants grow vigorously.

This plant cannot be confounded with any other single species. Some southern *Opuntiæ* have similar or even more elongated joints, but are erect and almost unarmed, such as *O. structa*, *O. tuberculata*, *O. lanceolata*, etc. *O. polyantha*, from South America, seems to be similar, but has smaller and more spiny joints, etc.

7. O. PHÆACANTHA, var. MAJOR, E. in Plant. Fendl. Mem. American Acad. IV. p. 52.

Near Zuñi. — As both Mr. Fendler and ourselves failed to collect the fruits of this form, it remains doubtful whether it has been justly referred here, or whether it is more closely allied to *O. Camanchica*.

O. MOJAVENSIS, E. & B.: prostrata, articulis grandibus suborbiculatus, pulvillis remotis, setis grandibus fulvis, aculeis 2–6 validis compressis acute angulatis elongatis plus minus curvatis, fuscis versus apicem pallidioribus annulatis, adjectis infra 1–3 minoribus tenuioribus pallidis; bacca pulvillis 20–25 fusco-setosis stipata. (Plate IX. figs. 6–8.)

On Mojave Creek. At the time it was considered identical with the following species, and no further notice taken of it; only a few fragments were brought home, together with a sterile fruit. Spines 1–2½ inches long, stout, bright brown; fruit 1¾ inch long, oblong; pulvilli crowded toward the upper end. It is possibly a distinct species, but the material too incomplete to permit us more than merely to indicate it.

8. O. CAMANCHICA, sp. nov.: articulis adscendentibus majusculis obovato-orbiculatis pulvillis remotis orbiculato-ovatis tomentum griseum setasque paucas stramineas fulvasve (in pulvillis terminalibus demum elongatis rigidiores)

gerentibus plerisque armatis; aculeis 1–3 s. ad marginem pluribus compressis fuscis s. atro-fuscis versus apicem pallidioribus superioribus elongatis suberectis ceteris deflexis gracilioribus flore? Bacca ovata late umbilicata atro-rubente succosa pulvillis remotis obsoletis seminibus majusculis irregularibus angulatis late marginatis. (Plate IX. figs. 1–5.)

On the Llaño Estacado, at the base of the hills, in rather fertile soil, from the eastern slope of that elevated plain to the Tucumcari hills, near the upper course of the Canadian River. A large plant, spreading extensively, with large rounded joints 6–7 inches long by 5½–7 wide; pulvilli about 1¼ inch remote; bristles dirty yellowish, greenish, or brown, inconspicuous except at the upper edge, where they often become elongated and stouter. Only the lowest pulvilli are spineless; the others bear 2–3 and the marginal ones 3–6 spines; larger ones 1½–2 and in some specimens almost 3 inches long. Flower unknown. Fruit very characteristic, distinguishing this species from the nearly allied *O. phœacantha;* it is oval, not narrowed or constricted at base, 1½–2 inches long, 1–1¼ inch in diameter, with a large flat umbilicus ¾–1 inch in diameter, considerably resembling the fruit of *O. Engelmanni*, of a deep red color, and a very sweet juicy pulp. Seeds 2¼–3 lines in diameter, very irregular, angular and often twisted, with sides impressed, mostly with a broad and thick acute or obtuse rim deeply notched at the hilum.

9. O. TORTISPINA, sp. nov.: prostrata, articulis majusculis adscendentibus obovato-orbiculatis, pulvillis [41] subremotis stramineo s. fulvo-setosis; aculeis 3–5 majoribus compressis angulatis subinde canaliculatis sæpe spiraliter tortis, albis basi apiceque sæpe corneis, adjectis infra aculeolis 2-3 gracilibus albis; flore ——; bacca ovata areolis sub-20 parvulis notata, late umbilicata, seminibus majusculis regularibus crassis. (Plate V. figs. 2–3.)

On the Camanche plains, near the Canadian River, east of the plateau of the Llaño Estacado. Similar in growth to the more Western *O. Camanchica.* Joints rounded, 6–8 inches long; pulvilli 1–1½ inches apart; bristles short, except on the edges, where they are 2–3 lines long, but rather slender; spines more numerous than in any other of our species, with juicy fruit, often 6–8, lower smaller ones ⅓–1 inch, larger ones 1½–2½ inches long, entirely white or yellowish horn-colored at base and tip; on the upper areolæ 1 erect spine, the others spreading in different directions, lower ones deflexed. Fruit similar to that of last species, large, oval, not contracted at base, perhaps less juicy and with a somewhat smaller and deeper umbilicus, 1¾–2 inches long, 1–1¼ in diameter. Seeds 2–3 lines across, thick and quite regular, with a very slight indentation at the hilum.

I had observed that sometimes two plants are produced from the same seed. This I found to be the case occasionally with *Opuntia occidentalis, Engelmanni,* and *dulcis,* one of the young plants always much larger and more vigorous than the other. In examining different seeds of this species, I succeeded in finding one with two embryos, (see figure), one spirally coiled around the other, both together appearing like one large one.

10. O. RAFINESQUII, Engelm.: diffusa radice fibrosa, articulis mediis s. majusculis obovatis s. suborbiculatis per-viridibus; foliis subulatis elongatis patulis pulvillis subremotis albido-s. griseo-villosis setas graciles rufas demum elongatas gerentibus plerisque inermibus; aculeis paucis plerumque solum marginalibus validis teretibus rectis albidis sæpe basi apiceque rufescentibus erectis s. patulis, singulis s. uno alterove graciliore deflexo adjecto; floris alabastro conico acuto, ovario clavato pulvillis 20–25 griseo-villosis rufo-setosis instructo; sepalis tubi sub-13 oblanceolatis acuminatis, interioribus late petaloideo-marginatis cuspidatis; petalis 10–13 late obovatis eroso-denticulatis sub-marginatis sulphureis basi intus miniatis, stigmatibus 7–8 erectis adpressis fluvo-albidis; bacca ovata basi angustata clavata subnuda pulposa purpurascente, umbilicoinfundi buliformi immerso; seminibus subregularibus compressis, margine plerumque lato compresso sub-acuto. Var. *microsperma* subinermis seminibus minoribus regularibus angustius marginatis. (Plate XI. figs. 1–3.)

In sterile, sandy, or rocky (consisting as well of sandstone as of limestone) localities in the Mississippi valley, Illinois, Missouri, Arkansas, and north to Wisconsin, east to Kentucky, and south probably to Louisiana and Texas; westward it has not been found west of the western boundary of Missouri and Arkansas. Flowers in May and June; fruit ripens in the same season, but remains on the plant till the following spring. Joints rather large, orbicular 3–4 inches in diameter, or obovate 4–5 inches long by 3 in width; a small variety with orbicular joints only 2 inches in diameter occurs on sandstone rock in southern Missouri. The color of the plant is dark or fresh green. Leaves 2½–4 lines long, diameter about one-fourth of the length; pulvilli 9–12 lines apart, with short whitish or grayish wool, and bright red-brown bristles conspicuous even in the youngest joints. Spines rarely none, generally few in var. *microsperma*, sometimes disappearing entirely in fertile soil in gardens, etc.; mostly only on the upper part or the edge of the joint, single or rarely 2–3, 9–12 lines long, rather stout, white with a darker tip, and sometimes also darker base. Flowers 2½–3½ inches in diameter, sulphur-yellow, mostly with a red centre. Fruit 1½–2 inches long, less than half that in diameter, narrowed at base, the seminiferous cavity not extending to the base; umbilicus funnel-shaped, but with shallow bottom, much wrinkled and scarred; naked by the disappearance of the bristles of the pulvilli; and edible, somewhat acid or sweetish. Seeds 2½ lines in diameter, hardly more than 1 line in thickness; rim [42] rather narrow, thick, but acutish. Var. *microsperma* has seeds only 0.8 or 0.9 line in diameter, more compressed, with quite a narrow rim.

This species has, by western botanists, generally been considered identical with the eastern *O. vulgaris*. Riddell mentions it as occurring in Kentucky and Illinois; Torrey & Gray in their Flora do not give any locality in the Mississippi valley; but Rafinesque had already observed it in Kentucky, and in his usual careless manner had indicated three species: *Cactus humifusus* (which, growing "from New York to Kentucky and Missouri," probably comprised both *O. vulgaris* and our species); *O. cæspitosa*, from Kentucky and Tennessee; and *O. mesacantha*, from Kentucky to Louisiana. As it seems impossible, from his incomplete descriptions, to make out what he meant by three different names, and as we know only one species in those States of the Mississippi valley, I take the liberty of discarding those names, and of substituting the name of the author for the western species. It is not improper to state here that Rafinesque's vague and partly erroneous descriptions have found their way into Seringe's Bulletin (1831, page 216), into the Linnæa (Vol. VIII.), into Pfeiffer's Enumeratio Cactearum (page 146), and into other works, but with the substitution of Nuttall's for Rafinesque's name as authority. The "rounded joints" have, in these works, been taken for "globose" or "cylindric" joints, and our plant has been classed with the *Opuntiæ glomeratæ* from Chili and Mendoza.

A large form of *O. Rafinesquii* was collected near Fort Smith, on the western border of Arkansas. Farther west, where no true *O. Rafinesquii* has been found, several forms were met with which, though they exhibit some distinctive characteristics, are perhaps not sufficiently different to constitute distinct species. The flowers of most of them are unknown, as well as the leaves; but fruit and seed were carefully preserved, which not only furnish important characters, but also the means to propagate, cultivate, and further to study them. We append them as sub-species.

1. Radice fibrosa.

a. O. CYMOCHILA: diffusa, articulis orbiculatis pulvillis subremotis griseo-tomentosis stramineo s. fulvo-setosis, plerisque armatis; aculeis 1–3 robustioribus elongatis teretibus s. subcompressis tortisque albidis basi sæpe rufescentibus, patulis deflexisve, additis sæpe 2–3 gracilioribus radiatim deflexis; flore? stigmatibus 8; bacca obovata umbilico plano s. parum depresso pulvillis 20–24 griseo-tomentosis parce setulosis, demum nudatis; seminibus irregularibus angulosis margine undulato acuto. (Plate XII. figs. 1–3.)

On the Camanche plains east of the Llaño Estacado, near the 100th degree of longitude; and from there to Tucumcari hill, 80 miles east of the Pecos. Joints $2\frac{1}{2}$–3 inches in diameter, orbicular or very slightly obovate; pulvillis 6–8 lines apart; the very light yellowish-brown bristles numerous, and conspicuous only on the older joints. Only the lowest pulvilli of a joint unarmed; upper ones with 2–5 spines; 2 or 3 larger ones, often reddish-brown at lower half, 1–2 inches long; lower, smaller, paler ones 3–9 lines long. Fruit oval, 1–$1\frac{1}{4}$ inches long, about 10 lines in diameter, purplish, pulpy, sweet, and edible, less contracted at base than *O. Rafinesquii*. Seed remarkably irregular and twisted, $2\frac{1}{2}$ lines in diameter, with a wavy or twisted very sharp rim, whence the name which indicates the undulated border.

The orbicular joints, the numerous spines, the oval not clavate fruit, and curiously twisted seed, seem to distinguish this form sufficiently from *O. Rafinesquii;* but these characters may not be sufficiently constant or important to constitute specific difference. The characters of *Opuntiæ* are not yet sufficiently studied to permit us to form satisfactory conclusions about their diagnostic importance; so we find a form collected on the Sandia mountains, near Albuquerque, which in habit and appearance does not differ from the common form of *O. Rafinesquii*, but which has the seeds of *O. cymochila*.

O. CYMOCHILA, *β*. MONTANA: articulis orbiculatis majoribus inermibus s. margine superiore solum aculeatis; pulvillis remotis stramineo-setosis; aculeis singulis binisve validis albidis infra fuscis; bacca obovata [43] subclavata seminibus irregularibus acute undulateque marginatis. Joints 3–$4\frac{1}{2}$ inches in diameter; pulvilli 9–12 lines apart; spines 12–18, smaller ones 4–6 lines long, on some plants entirely wanting. Fruit $1\frac{1}{2}$ inches long, much contracted at base, with a much depressed, almost funnel-shaped umbilicus. Seeds cannot be distinguished from those of the plant of the plains.

b. O. STENOCHILA: prostrata, articulis obovatis, pulvillis remotis stramineo-setosis superioribus solum armatis; aculeis singulis albidis patulis, 1–2 minoribus deflexis sæpe adjectis; bacca obovata clavata pulposa, umbilico lato parum immerso, seminibus regularibus crassis anguste obtuseque marginatis. (Plate XII. figs. 4–6.)

At the cañon of Zuñi. Joints 4 inches long and 3 wide, flaccid or often lying flat on the ground (in November); pulvilli 12 lines apart, small, with yellowish or greenish bristles; larger spines 1–$1\frac{1}{4}$ inches long, smaller ones less than half as long. Fruit green or pale red, very juicy, $1\frac{1}{2}$ inches long, but sometimes much enlarged, even more juicy, and 2–$2\frac{1}{2}$ inches long and 1 inch in diameter above, long clavate toward the base. Seeds quite characteristic, about $2\frac{1}{2}$ lines in diameter, $1\frac{1}{2}$ line thick, regular, with a very narrow and somewhat obtuse rim, whence the name.

In the same neighborhood another plant was found with similar seed, but smaller, more rounded, and somewhat more spinous joints, fruit less clavate, smaller, seeds similar, but a little smaller.

2. Radice tuberosa.

c. O. FUSIFORMIS: **diffusa s. adscendens, radicibus fusiformibus elongatis, irregulariter incrassatis; articulis suborbiculatis majusculis, foliis elongatis subulatis patulis pulvillis subremotis griseo villosis, setas elongatas virescente-fuscas gerentibus, plerisque s. solum superioribus armatis; aculeis 2–3 gracilibus inæqualibus deflexis s. patulis, albidis; floris minoris flavi (basi rubelli?) ovario pulvillis 25 stipato, stigmatibus 8, bacca ovata basi vix clavata demum nudata, pulposa rubella, umbilico immerso subinfundibuliformi; seminibus subregularibus crassis majusculis acute marginatis.** (Plate XII. figs. 7–8.)

Cross-timbers longitude 97°–99°; west of the region inhabited by *O. Rafinesquii*, and east of that of *O. cymochila*. Also collected by Dr. Wislizenus in the same longitude, but farther north, on Cow Creek and the Little Arkansas (on the road from Independence to Santa Fé); and by Dr. Hayden, of the United States Army, on the Missouri, below the Big Bend. Flowers in May. Roots form elongated tubers, attenuated at one or both ends ½–1 inch in diameter; joints 4 or even 5 inches in length; leaves 2½–3½ lines long; pulvilli 9–12 lines apart, with numerous stout yellowish-brown bristles, often 2 lines long; spines 1 or 2, 1–1¼ inches long, with a smaller one of half the length, more slender than in most other allied forms. Flowers 2–2½ inches in diameter; yellow, apparently with red base; smaller and with fewer sepals than *O. Rafinesquii*, but the same number of stigmata. Fruit 1½ inches long; umbilicus ½ inch wide. Seed rather larger and thicker than in *O. Rafinesquii*, 2¾ lines in diameter and 1½ thick. The description of the flower is from the specimens collected by Dr. Wislizenus.

O. MACRORHIZA, Engelm., of Texas, also belongs here as another tuberous-rooted form in the wide circle of *O. Rafinesquii*.

11. O. BASILARIS, sp. nov.: **humilis, articulis obovatis s. subtriangularibus glaucescentibus pubescentibus adscendentibus e basi proliferis, fere rosulatis; foliis subulatis minutis erectis rubellis tomentum axillare vix superantibus; pulvillis subconfertis fulvo-tomentosis setas gracillimas demum numerosissimas breves fulvidas et subinde aculeolos setiformes caducos gerentibus; floris purpureis ovario obovato pubescente pulvillis plurimis (40–60) confertis fulvo-tomentosis instructo, sepalis 20–25 exterioribus oblanceolatis acuminatis, interioribus late obovatis cuspidatis, petalis sub-10 obovato-orbiculatis retusis s. obcordatis sæpe tenuiter mucronatis, stigmatibus 8 brevibus in capitulum conicum congestis; bacca (sicca?) breviter obovata late umbilicata, seminibus magnis crassis subregularibus.** (Plate XIII. figs. 1–5.) [44]

On hills and in ravines from the Cactus Pass down the valley of Williams's River to the Colorado and to Mojave Creek. Mr. Schott met with it on the lower Gila; and both he and Mr. Albert H. Campbell obtained the beautiful purple flowers of this plant in April and May, 1855. The habit of this plant is very different from any other of our *Opuntiæ*, as the stout obovate or often fan-shaped or sometimes almost obcordate joints originate from a common base, and form a kind of rosette resembling somewhat an open cabbage-head. Among thousands of specimens observed none deviated from this peculiar manner of growth, none was proliferous in the shape of the other elliptic *Opuntiæ*. Joints 5–8 inches long, ½ inch in thickness, minutely pubescent. Leaves only 1 line in length, slenderly subulate, smaller than any other of our species; next in size are the leaves of *O. Missouriensis*, *O. fragilis*, and *O. filipendula*; the largest leaves are produced by the cylindric *Opuntiæ*, some of which have them 10 lines long.

Pulvilli somewhat immersed, 4–6 lines apart. Flower of a beautiful and rich purple color, about 2½ inches in diameter; ovary nearly 1 inch long, crowded with 40–60 elevated areolæ, with light brown wool and brighter brown bristles; filaments not very numerous, leaving the inner base of the tube naked; stigmata about 2 lines long or less, apparently green. Fruit seems to be perfectly dry, short, and thick. Seeds 3 lines in diameter, nearly 2 lines thick, with a rather narrow but very thick rim, regular or sometimes quite irregular.

12. O. HYSTRICINA, sp. nov.: **diffusa, articulis obovato-orbiculatis, compressis, pulvillis subconfertis magnis griseo-tomentosis setas pallidas rutilasve gerentibus, omnibus armatis aculeis 5–7 inferioribus gracilioribus brevioribus albidis deorsum radiantibus, superioribus 5–8 elongatis validioribus angulatis sæpe tortis flexuosisve 3–4 deflexis albidis, uno alterove longissimo, ceteris 2–4 superioribus patulis suberectisve sæpe basi s. ad medium fuscatis; flore ——, bacca obovata subclavata, umbilico parum immerso planiusculo, pulvillis 25–30, inferioribus inermibus, superioribus confertis aculeolos paucos gerentibus; seminibus maximus irregularibus late crasseque marginatis.** (Plate XV. figs. 5–7.)

This beautiful species was found abundant from the Rio Grande westward to the San Francisco mountains, mixed with *O. Missouriensis*, to which it is nearly allied. The specimens before us were obtained at the Colorado Chiquito and on the San Francisco mountains. Joints 3–4 inches long and nearly as broad; pulvilli 5–6 lines apart, unusually large. Lower radiating spines 4–9 lines; the others 1½–3 and even 4 inches long, irregularly arranged, as we generally find it in this species. We notice many specimens where 3 or 4 larger spines are placed above the lower short radiating ones; the uppermost one of them is usually the longest. Somewhat above these are 2–4 other spines, the lower one of which is the darkest, and often not much shorter than the one just mentioned; the others are shorter and whitish, or dark only at the base. The bristles are yellowish in some and brown in other specimens; some-

times we find short pale and longer darker bristles together. The fruit is 1 inch long and half as thick, with a very shallow umbilicus; only the upper larger pulvilli bear 4–6 spines (2–5 lines long); the lower ones on the contracted part of the fruit are very small, distant, and unarmed. Seed among the largest in this genus $3\frac{1}{2}$ lines in diameter, the thick and broad rim acutish. The name indicates the porcupine-like armature of this species.

13. O. MISSOURIENSIS, DC.: prostrata, radice fibrosa, articulis obovatis suborbiculatisve tuberculatis compressis læte viridibus adscendentibus, foliis subulatis minutis patulis, pulvillis subconfertis albo s. griseo-tomentosis stramineo — setosis omnibus armatis; aculeis in pulvillis inferioribus gracilioribus paucioribus, in superioribus 5–10 exterioribus minoribus radiantibus albidis, 1–5 interioribus robustis teretiusculis longioribus patulis, rarius suberectis, albidis s. rufescentibus; floribus sulphureis basi intus sæpe aurantiacis, ovario obovato subgloboso, pulvillis 25–35 albo tomentosis aculeolatis instructo; sepalis tubi sub-13 exterioribus oblanceolatis, interioribus [45] obovatis cuspidatis petaloide-marginatis, petalis sub-13 obovato-orbiculatis emarginatis s. obcordatis crenulatis sæpe mucronulatis; stigmatibus sub-8 viridibus in capitulum globosum s. conicum confertis; bacca ovata s. subglobosa, umbilico parum depresso, pulvillis 25–35 albo-tomentosis setos albidas stramineas s. rufescentes aculeolosque numerosos breves s. elongatos gerentibus; seminibus magnis plerumque irregularibus late subacuteque marginatis. (Plates XIV. and XV. figs. 1–10 and 1–4.)

This variable species extends from the country north of the upper Missouri River to the regions south of the Canadian and of Santa Fé, latitude 48° 35′; and from longitude 99° east of Fort Pierre, on the Missouri, to 112° on the San Francisco mountains. It has not been found south of Albuquerque, along the Rio Grande, nor in the Salt Lake valley, Utah, as far as at present known. Flowering in May; fruit same fall. Nuttall discovered this common western species on the upper Missouri in 1811, and described it under the name of *Cactus ferox;* he noticed "8–10 greenish stigmata" and the "dry spring fruit." The deep purple fruit, "as large as a hen's egg," attributed to our species, on the authority of Dr. James, by Torrey and Gray, in their Flora, perhaps belongs to our *O. Camanchica;* it certainly cannot belong to *O. Missouriensis.*

It forms large spreading masses, much dreaded by travellers and their animals. Joints mostly suborbicular, 2–4 inches long and 2–$3\frac{1}{2}$ wide, light green, somewhat tuberculated from hemispherical elevations which bear the leaves and pulvilli, 4–6 lines apart; leaves $1\frac{1}{2}$–2 lines long, hardly more than $\frac{1}{2}$ line in diameter at the base, nearly twice as long as the wool in their axils. Numerous small white spines radiating downward and laterally, sometimes a few rather longer ones obliquely upward, mostly 3–6 lines long, rarely more elongated; central spines in the Missouri specimens mostly 1, rarely 2; in the southern ones often 2–4, 1–$1\frac{1}{2}$, or even 2 inches long, terete or somewhat angular, white, or mostly with a reddish base when young, entirely brown-red, with lighter tips. On the lower pulvilli the stouter spines are mostly wanting; in some Missouri specimens I find few and weak spines on the upper, and none at all on the lower part of the joints; in other plants from the same region all the pulvilli are nearly equally armed with 5 weaker (2–3 lines long) lower deflexed, and 5 inner stouter (4–6 lines long) spreading spines. Flowers 2–3 inches in diameter; ovary, with subulate sepals, similar to the leaves; spines already present, but not as long and stiff as in the fruit. Petals yellow towards the base, or sometimes almost entirely rose-colored, orange, or brick-colored, sometimes only the margin remaining yellow. Exterior filaments much the longest, deep red; interior ones paler, shorter. Pistil pale-yellowish, thickened below the middle, as in almost all the species of this genus. Stigmata united into a small subconic head.

Fruit ovate, or sometimes globose; umbilicus shallow; spines on the pulvilli numerous, 6–12 usually short, 1–4 sometimes 6 lines long. Seeds about 3 lines in diameter, sometimes larger, in one form much smaller, mostly irregular, twisted, angular, much compressed, with a broad and thick but rather acutish rim. Embryo of different shapes conform to the shape of a seed, always with a small albumen.

The following forms, we think, must be included under this species, though the whole history of most of them is not known; some of them may not even be constant varieties.

α. RUFISPINA: articulis orbiculatis s. transversis setis parcis rufescentibus, aculeis radialibus 6–8 albidis rufo-variegatis, interioribus validis fuscis apice pallidioribus, 2–4 deflexis, singulo patulo s. suberecto robustissimo; bacca ovata. (Plate XIV. figs. 1–3.)

This is the shortest form of our species, and greatly deserves Nuttall's original name "ferox." It was collected on rocky places on the Pecos; Dr. Hayden has also sent it from the Yellowstone; and it no doubt is met with in all the intervening territory. Joints 2–3 inches in diameter, pulvilli 4–5 lines apart; bristles fewer, but longer and darker than in other forms; central spines $1\frac{1}{4}$–2 inches long. Fruit 1 inch long, half as thick, with shallow umbilicus; about 30 pulvilli, spines on the upper ones 4–6 lines long. Seeds $2\frac{1}{2}$–3 lines in diameter.

β. PLATYCARPA: articulis obovato-orbiculatis, setis parcis stramineis, aculeis exterioribus 5–10, inferiori- [46] bus albidis, superioribus robustioribus rufescentibus centrali subsingulo robusto fusco patulo s. deflexo; bacca depresso-globosa, umbilico lato plano, pulvillis sub-25 aculeolos 5–10 breves gerentibus. (Plate XIV. fig. 4.)

Sent from the Yellowstone by Dr. Hayden. A stout form. Joints 3 inches long, $2\frac{1}{2}$–$2\frac{3}{4}$ wide; pulvilli 4–6 lines apart; the dirty yellowish bristles visible only on the older joints. Central spines single, or only on vigorous specimens on the upper pulvilli 2, mostly brownish, deeper colored on the margin. Fruit 8–9 lines long, umbilicus of the same diameter; spines only 1–3 lines long, deflexed. Seed 3 lines in diameter; rim rather narrower than in the first-mentioned form.

γ. MICROSPERMA: articulis ut in præcedente; stigmatibus 5; bacca ovata, umbilico parum depresso, pulvillis 20–30 setosis et breviter aculeolatis, seminibus anguste acuteque marginatis. (Plate XIV. figs. 5–7.)

On the Missouri, about Fort Pierre; brought down ten years ago by the fur traders. Very similar to the last form in the general appearance. Also with only 1, or at most 2, central dark spines; flowers only with 5 stigmata, otherwise same as the one described above; fruit short, oval, with 10–20 very short spines on the numerous pulvilli; seed only 2 lines in diameter, more regular, thicker in proportion, with a narrow and acute rim. It might be supposed that these characters were important and constant enough for a specific difference, if we did not know the great variability in this genus, and if we did not find among Dr. Hayden's plants seeds of intermediate shape and size.

δ. SUBINERMIS: articulis elongato-obovatis, pulvillis subremotis, inferioribus, inermibus, superioribus aculeos paucos breves gerentibus.

Brought from the upper Missouri by Dr. Hayden; remains constant in three years' cultivation. Joints $3\frac{1}{2}$–5 inches long, half as wide, gradually narrowed down at base; leaves entirely similar to those of the common form; pulvilli 6–9 lines apart; spines entirely wanting, or on the upper pulvilli 2 or 3 short and slender ones, rarely one or the others more robust, $\frac{1}{4}$–$\frac{1}{2}$ inch long. Flowers not seen.

ε. ALBISPINA: articulis late obovatis, setis stramineis, aculeis omnibus albis gracilioribus, exterioribus 6–10 setaceis, interioribus in pulvillis superioribus 1–3 robustioribus elongatis deflexis s. patulis; bacca ovata, seminibus magnis. (Plate XIV. figs. 8–10.)

Sandy bottoms and dry beds of streamlets on the upper Canadian, 250 miles east of the Pecos; on the Sandia mountains near Albuquerque; also on the upper Missouri. This was the first form of this species met with in travelling up the Canadian; the stouter and more compact forms were found farther west, in higher elevations. Joints 3–4 inches long, $2\frac{1}{2}$–3 wide; pulvilli 4–6 lines apart; spines all ivory white, rarely with a yellowish tinge, larger ones 1–$1\frac{1}{4}$ inch long; fruit with very shallow umbilicus, and very slender and short spines; seed 3–$3\frac{1}{2}$ lines in diameter, irregular, rim broad acutish. A form from the Sandia mountains — with pulvilli more remote, spines longer, more slender, some of them flexuous — seems to unite this with the next variety.

ζ. TRICHOPHORA: articulis ovatis, pulvillis confertis parce albo-tomentosis setas stramineis demum albidas breves gerentibus, omnibus armatis; aculeis 10–18 setiformibus albis, exterioribus 8–12 brevioribus radiantibus, interioribus longioribus deflexis, rarius singulo suberecto; pulvillis in articulis vetustioribus lignosis confertissimis setas numerosas aculeosque 15–25 capillaceos elongatos flexuosos gerentibus; bacca ovata, umbilico parum immerso pulvillis 35–40 albo-tomentosis stramineo-setosis fasciculum aculeolorum 12–18 plerumque deflexorum gerentibus; seminibus maximis valde compressis irregularibus latissime acuteque marginatis. (Plate XV. figs. 1–4.)

Only on the volcanic rocks about Santa Fé, and on the Sandia mountains. The hoary appearance of the older joints is very characteristic, and reminds one strongly of *Pilocereus senilis*. These hairs are from a few lines to 2 or $2\frac{1}{2}$ inches in length, and of the appearance and about as fine as an old man's beard. The older joints [47] become thick and of a solid ligneous substance, younger joints $4\frac{1}{2}$ inches long, $2\frac{1}{2}$ inches wide, or larger; pulvilli 4–5 lines apart; exterior spines 3–6 lines, interior ones 9–18 lines long. Fruit ovate, 10 lines long, 7 in diameter; very slender and numerous spines, 3–6 lines long. Seeds, with those of *O. hystricina*, the largest known to us, $3\frac{1}{2}$ lines in diameter, sometimes larger; rim large, almost of the thickness of the seed itself. This is perhaps a distinct species, and must be further studied.

14. O. SPHÆROCARPA, sp. nov.: diffusa, articulis orbiculatis transversisve tuberculatis; pulvillis confertis albo-tomentosis, setas stramineas breves gerentibus, plerisque inermibus, summis solum et marginalibus aculeos 1–2 reflexos s. patulos, adjectis subinde 1–3 brevioribus gerentibus; bacca globosa, umbilico minore plano, pulvillis sub-25 tomentosis setosis vix aculeolatis, seminibus mediis acute marginatis. (Plate XIII. figs. 6–7.)

On the eastern declivity of the Sandia mountains, near Albuquerque. Joints in the specimen before us 3 inches wide, less in length, strongly tuberculated; pulvilli 4–5 lines apart. Spines on the upper lateral pulvilli mostly single, deflexed, $\frac{1}{2}$ inch long; on the middle or lower ones none; on the uppermost and marginal ones mostly 2, rarely 3 lines long, reddish brown, with darker tip; 1–3 smaller additional spines, 2–4 lines long, also reddish. Fruit perfectly globose, 9 lines in diameter; umbilicus 5–6 lines wide; pulvilli bristly, but only the upper ones with 1 or a few small spines. Seeds $2\frac{1}{2}$ lines in diameter, very irregular, with a rather narrow but sharp rim.

The arrangement of the spines is so different from any form of *O. Missouriensis* — which always shows the

numerous slender radiating spines, and always has spiny fruits — that we feel obliged to separate this plant as a distinct species. The seeds brought home by the expedition have germinated, and are growing vigorously.

15. O. ERINACEA, sp. nov.: diffusa, adscendens; articulis tumidis ovatis s. teretiusculis, pulvillis confertissimis ovato-orbiculatis albo-tomentosis demum stramineo-setosis omnibus armatis; aculeis 3–5 gracilibus elongatis e cinereo-rubellis 1–3 superioribus brevioribus sursum porrectis, centrali longiore patulo vel declinato, ceteris deflexis, additis 2–4 minoribus inferioribus; bacca ovata umbilico infundibuliformi pulvillis 30–40 setas stramineas et aculeolos 12–20 gerentibus; seminibus magnis subregularibus late acuteque marginatis. (Plate XIII. figs. 8–11.)

West of the great Colorado, near the Mojave Creek. Joints 2–2½ inches long, 1–1½ inches wide, and about ½–¾ inch thick, sometimes elongated, almost cylindric, densely covered with the large white pulvilli, which are only 2–3 lines apart, and numerous reddish-gray spines with red points bristling hedgehog-like (whence the specific name) in every direction. Spines 6–14 or in old joints even 20 lines long, with smaller ones very slender, flexible, but stiff. Young plants cylindric, covered with bunches of 15 or 20 or more white hair-like spines. Bristles dirty-yellow, even in young joints present, in old ones densely crowded and 2–3 lines long; in a dead flower a 6-parted stigma was noticed. Fruit 1–1¼ inches long, about ½ an inch in diameter, with a deep funnel-shaped umbilicus; pulvilli crowded, prominent, white-tomentose with yellowish bristles, and numerous, mostly deflexed spines, 3–6 lines long. Seed nearly 3 lines in diameter, much compressed, more regular than in the three foregoing species.

16. O. BRACHYARTHRA, sp. nov.: prostrata s. adscendens, articulis ovatis s. orbiculatis tumidis sæpe subglobosis, tuberculatis; pulvillis confertis magnis albo-tomentosis parce setulosis plerisque armatis; aculeis 3–5 albidis s. fuscatis patulis; 1–2 validioribus sursum versis, cæteris minoribus minimisque subdeflexis; floris parvi; ovario subgloboso, pulvillos 12–15 tomentosos setosos superiores aculeolatos gerante, sepalis tubi exterioribus obovatis cuspidatis stigmatibus 5. (Plate XII. fig. 9.)

At the foot of the Inscription Rock near Zuñi, under pine-trees; only seen in that single locality. A singular-looking plant, with short tumid joints (10–15 lines long, 10–12 wide and nearly the same in thick- [48]
ness), one growing on the top of the other, so as to resemble somewhat a jointed finger. In the absence of ripe fruit we are unable with certainty to class this species. The shape of the joints and the somewhat spinulose fruit seem to bring it very near to *O. fragilis*, and it may possibly be a small and compact form of this species, though the appearance is very different; on the other hand, the subglobose joints seem to refer it to the section *Glomeratæ*, Salm.

Pulvilli 2–4 lines apart, large, white or when old grayish tomentose, with very few short yellowish bristles, even in the old joints; spines 9–12 lines long, rather stout, terete, often with 1 or 2 short ones not more than 1–2 lines long. No ripe fruit was found (November), — which is also often the case with *O. fragilis*, — but many remains of flowers, with globose-ovate fleshy sterile red ovaries, 3–4 lines long, some of them becoming larger and probably proliferous; generally only some of the upper pulvilli bear a few short spines. The flower seems to have been about 1 inch in diameter, with about 5 sepals, 8 or 9 petals, and style with 5 stigmata.

O. FRAGILIS, Haw., — the seed of which we give a figure of (Pl. XXIV. fig. 5), — grows on the upper Missouri and Yellowstone, and probably down to Santa Fé. The joints are small, ovate, compressed or turned, or even terete; 4 larger spines on the upper fully developed pulvilli cruciate, the upper one suberect, stouter and longer than the others, mostly yellowish-brown; on the lower margin 4–6 small white radiating spines; bristles few. Fruit apparently somewhat fleshy, getting dry much later, with 20–28 pulvilli, almost naked, only the upper ones with a few short spines. Seeds few, large, regular.

Subgen. 2. CYLINDROPUNTIA, Engelm.

§ 1. *Clavatæ.*

17. O. CLAVATA, E. in Wisliz. Rep. (Pl. XXII. fig. 1–3). Found from Santa Fé to Albuquerque, — where Wislizenus and Fendler had already collected it, — and nowhere else. A remarkable and well-characterized species, the type of this section. We add to the characters previously published (Wislizenus's Report, note 12, and Plantæ Fendlerianæ in Mem. Amer. Acad. Vol. IV. p. 49), that the leaves are long and subulate, 2–2½ lines long; the broadest spines were 1½ lines wide; fruit 1½–1¾ inch long, lemon-yellow, almost covered with 30–50 hemispherical pulvilli, which bear innumerable white slender bristles, spreading ray-like in every direction. Seeds large for this section, and, as in all the allied species, transverse or broader than high, 2¼-3 lines in the longest diameters, rostrate, somewhat angular; commissure (which in the cylindric and clavate opuntiæ replaces the rim of the flat-jointed ones), impressed, linear or a little wider; cotyledons, in several seeds examined by me, oblique.

18. O. PARRYI, E. in Sillim. Journ. Nov. 1852: articulis ovatis basi clavatis, tuberculis oblongo-elongatis pulvillis albo-tomentosis setas paucas rigidas gerentibus; aculeis angulatis scabris rubello-cinereis, interioribus validioribus sub-4 triangulato-compressis, exterioribus 5–8 angulatis supra infraque divergentibus, extimis 6–10 gracilibus

rigidis radiantibus ; bacca ovato basi clavata pulvillis sub-40 setosissimis stipata ; seminibus regularibus latius commissuratis. (Plate XXII. figs. 4–7.)

On the gravelly plains thirty miles west of the Colorado, near the Mojave River ; southward to the eastern slope of the California mountains, near San Felipe, Dr. Parry. Joints 2½–3 or 4 inches long, 1¼ inch in diameter, attenuated not only below but also somewhat above in the specimen before us. Tubercles about 9 lines long ; pulvilli small ; bristles few, coarse and long. Spines very numerous, in three series : the 4 inner ones 12–16 lines long, ½–¾ line broad, the lower one somewhat flattened, the others triangular ; the next series consists usually of 2–3 upper ones and 3–5 lower ones, angular, more slender and shorter than the first, 4–8 lines long ; the third or external circle consists of 6–10 bristly slender spines, 3–4 lines long, some above, but most of them lateral or inferior. Young [49] spines reddish-gray, with paler margins ; older ones ashy. Fruit 1½ inch long. Seed rather regular, 2–2½ lines in the transverse diameter, less than 2 lines high, not beaked; commissure broader and more distinct than in any other of this section examined by us. Cotyledons in all the seeds examined oblique.

This description refers to the plant brought by the expedition from the Mojave River. Several years before, Dr. Parry had described a plant discovered by him "on the hills and plains about San Felipe, on the eastern slope of the California mountains," which had been named after the discoverer. We presume that both plants were identical; but have to remark that Dr. Parry's plant is much larger, having joints of 4–8 inches in length, with tubercles 6–12 lines long ; spines whitish, half an inch long. He describes the flowers as 1½ inch in diameter, greenish-yellow, with green stigmata. Fruit not mentioned. Further investigation will be necessary to clear up those doubts.

From *O. clavata* (which grows 8 or 9 degrees east, and on much greater elevation) the Mojave species is distinguished by the shape of the joints, the color, much narrower more numerous spines, and the smaller more regular seeds, with the broad commissure.

§ 2. *Cylindricæ.*

19. OPUNTIA DAVISII, sp. nov.: caule dense lignoso ramosissimo divaricato adscendente, articulis junioribus erectis elongatis, basi attenuatis ; tuberculis oblongo-linearibus prominulis, setis stramineis tenerrimis ; aculeis interioribus 4–7 subtriangularibus rufis apice pallidioribus, vagina straminea laxa fulgida indusiatis divergentibus s. deflexis, aculeis gracilioribus inferioribus 5–6 ; bacca ovata pulvillis sub-25 setas stramineas aculeolosque paucos gerentibus ; umbilico lato. (Plate XVI. figs. 1–4.)

Common on the upper Canadian, eastward and westward of Tucumcari hills, near the Llaño Estacado. A very much branched, shrubby, somewhat procumbent plant, with erect joints, about 18 inches high ; wood dense and hard. Joints 4–6 inches in length and ½ an inch or more in thickness ; tubercles not very prominent, 7–8 lines long ; very slender bristles, forming a thick brush at upper end of pulvillus. Interior spines 1–1¼ inches long, covered with a very loose glistening membranaceous sheath, which makes the plant an object of remark for a long distance ; lower spines 3–6 lines long. All the fruits seen on the route were sterile, and most of them elongated, 1–1¼ inch long ; on many pulvilli 1–4 sheathed spines were observed, which possibly are peculiar only to the sterile and proliferous fruits.

We have named this well-marked and pretty species after our enlightened Secretary of War, Colonel Jefferson Davis, under whose auspices the expeditions for the exploration of a proper route for the Pacific Railroad were organized, and were enabled to accomplish so much, not only for this specific object, but also for the elucidation of the natural history of this hitherto almost unknown country.

20. O. ECHINOCARPA, sp. nov. : caule reticulato-lignoso erectiusculo, ramis numerosis patentissimis subinde pene decumbentibus, articulis ovatis basi clavatis, tuberculis ovatis prominentibus confertis, setis paucis stramineis ; aculeis albidis stramineo s. albido-vaginatis, majoribus sub-4 cruciatis, ceteri, minoribus 8–16 undique radiantibus ; floris flavi (?) ovario pulvillis 30–40 villosis subaculeolatisque confertis stipato, sepalis sub-13, exterioribus ovatis acutis ; interioribus obovatis mucronatis, petalis sub-8 obovatis obtusis s. subemarginatis denticulatis, stigmatibus 6 ; bacca globoso-depressa s. hemispherica, late profundeque umbilicata pulvillis sub-40 aculeolos vaginatos elongatos 8–12 gerentibus dense stipata floris, rudimento subpersistente coronata ; seminibus subregularibus s. angulatis, crassis, late commissuratis, cotyledonibus parallelis.

In the Colorado valley, near the mouth of Williams's River. Mr. Schott found a stouter form farther south. The more northern plant forms a low shrub 6–18 inches high, spreading, and often partially prostrate ; [50] the cylindric tubular wood is reticulated with short meshes. Joints 1–2½ inches long, less than 1 inch thick ; tubercles not more than 4 or 5 lines long ; bristles few and rather coarse. Spines 12–20 ; the 4 larger ones are somewhat central, 9–12 lines long; the others radiating 4–9 lines long ; the smaller ones, as in all these Opuntiæ, hardly vaginate. Flower described from a withered specimen found attached to a fruit, to which it somewhat adhered, but perhaps held more by the long intricate spines than by an organic attachment. Flower 1½–1¾ inches in diameter, apparently yellow, which is uncommon among the *Cylindric Opuntiæ;* petals about 9 lines long and 3 broad; stigmata about 2 lines long. The fruit is very peculiar, and, with the seed, characterizes this species well. The wide

umbilicus on the shallow fruit gives it the appearance of a saucer, and the seeds find their place more around the edge of the umbilicus than in the body of the fruit. Spines on fruit from 4 to 10 lines long. Seed 2 lines or more in diameter, with a broader commissure than any of the allied species; cotyledons always; all the specimens examined regularly accumbent or parallel (the only species, so far, where this regularly is the case); albumen unusually large.

O. serpentina, from San Diego, is very nearly allied to our species, but seems sufficiently distinct by its elongated cylindric joints and different growth.

21. O. Bigelovii, Engelm.: caule arborescente erecto crasso reticulato-lignoso, ramis erectis adscendentibusve numerosis congestis, inferioribus demum refractis, articulis ovatis s. ovato-cylindricis tumidis læte s. pallide viridibus fragilibus; tuberculis subhemisphericis depressis confertis; pulvillis immersis ovatis setas pallidas penicillatas et aculeos 6–10 robustiores pallidos stramineo-vaginatos, 3 deflexos, ceteros divergentes et 6–10 graciliores inferiores radiantes gerentibus; ovario tuberculis plurimis stipato parce aculeolato; bacca ovata profunde umbilicata tuberculata pulvillos immersos 60–70 setigeros inermes s. aculeolos sub-3 vaginatos gerente; seminibus parvis. (Plate XIX. figs. 1–7.)

On Williams's River, a branch of the Colorado; 10–12 feet high, stem $\frac{3}{4}$ inch in diameter; skeleton forming a large hollow tube, much reticulated with numerous small roundish or somewhat rhombic meshes in 13 or 21 spiral rows; branches forming a dense head. Younger joints erect, adpressed very fragile, often shaken off by the wind and covering the soil around, taking root everywhere, or sticking to the clothes of the passers-by like burrs; the joints on the older part of the stem are often persistent and reflexed, becoming withered and brown. Joints 2–6 inches long, 1–2 inches in diameter, light fresh green, covered with the small, almost hemispherical and not very prominent tubercles, which are 3–4 lines long, and arranged mostly in 13 spirals; the areola is immersed at the apex of the tubercle, and surrounded by an elevated paler or almost whitish ridge, having the appearance of 2 lateral glands. Larger spines about 1 inch long. Flower or complete fruit not seen. An ovary or young fruit before me is clavate, 1 inch long, and has a few spines on the pulvilli. Some empty (sterile?) fruits brought home are oval, $1\frac{1}{2}$–$1\frac{3}{4}$ inches long, 1 inch in diameter, strongly tuberculated, and spineless; others again are even larger, with more numerous tubercles, and the pulvilli beset with 3–6 sheathed spines 4–7 lines long; these are evidently undergoing a change into joints. Proliferous seeds, said to be small; but most unfortunately the specimens were lost, so that we were unable to compare them with those allied species found farther south (*O. fulgida*) and on the Pacific coast (*O. prolifera*). Our plant is distinguished from these forms by its short tubercles, immersed pulvilli, and large tuberculated and somewhat spiny fruit.

[I have thought proper to consecrate this remarkable species, so conspicuous in its desert wilds, to my colaborer Dr. J. M. Bigelow, through whose intelligent exertions and indefatigable assiduity so many new Cactaceæ, described in this report, have been discovered and brought home. — G. E.]

22. O. Whipplei, sp. nov.: caule erecto s. rarius patulo s. subprocumbente, reticulato-lignoso, divaricato ramoso, articulis cylindricis; tuberculis ovatis confertis, pulvillis pulvinatis parce tomentosis vix setosis; [51] aculeis brevibus cinereo s. stramineo vaginatis, 1–4 majoribus divaricatis, inferiore longiore deflexo, minoribus 2–8 solum ad inferiorem pulvilli marginem deflexis s. undique radiantibus; flore rubro, ovario ovato tuberculato pulvillis 20–30 tomentosis setas stramineas et aculeolos paucos mox deciduos gerentibus stipato sepalis tubi sub-8 orbiculatis cuspidatis, petalis 8–10 spathulatis cuspidatis; bacca subglobosa leviter tuberculata subcarnosa flava inermi; umbilico infundibuliformi seminum subregularium commissura lineari.

α. lævior, humilior, aculeis brevioribus paucioribus, seminibus minoribus.

β. spinosior, elatior, aculeis plurimis longioribus, seminibus majoribus. (Plate XVII. figs. 1–4.)

From the elevated country about Zuñi to the head of Williams's River; at first seen only 8–15 inches high, subprostrate, afterwards 20–30 inches, and sometimes even 5–6 feet high. Var. β. was found by Mr. A. Schott south of the Gila River; and he also discovered the flower of this plant, which, like the flowers of all the other new species, remained unknown to us, unless winter remains were picked up here and there. Ligneous skeleton tubular, with small meshes, dense at base of stem; joints elongated, 2–4 inches to a foot long, $\frac{1}{2}$ or $\frac{3}{4}$ of an inch in diameter; tubercles ovate or sometimes almost rhombic, about 5 lines long. Spines very variable in number, sometimes only with 1 larger and 2 or 3 smaller ones; in other instances, especially in var. β., with 12 or 14; spines 3–9 lines long; bristles few, generally only on older joints. Flowers $1\frac{1}{4}$–$1\frac{1}{2}$ inches in diameter; ovary 6–9 lines long, with 20 or 25 pulvilli. Fruit about 1 inch long, a little less in diameter, somewhat fleshy and sweet, with 25–35 not very prominent tubercles. Seeds with linear or almost linear commissure, $1\frac{1}{2}$–$1\frac{3}{4}$ lines in diameter; cotyledons regularly incumbent or sometimes oblique; the seeds of β. are 2 lines in diameter.

This is easily distinguished from all the allied species by the slender elongated branches, the short crowded tubercles, and the short spines. We have dedicated this Opuntia — characteristic of the desert mountains under the 35th degree, between the Rio Grande and the Colorado — to Captain A. W. Whipple, the commander of the expedition,

who, by his zealous and liberal co-operation, afforded every facility in his power in the various collections of natural history. (Plate XVII. figs. 5–6, and Plate XVIII. fig. 4.)

23. O. ARBORESCENS, Engelm. Found first 200 miles east of the Pecos, and from there abundantly as far west as Zuñi, where other cylindric *Opuntiæ* take its place. In this region it does not grow higher than 5–8 feet, and can scarcely be called arborescent. It is always well characterized by the verticillate often somewhat pendulous branches, the cristate-tuberculate spineless fruit, and the smooth seeds with a distinct and broadly linear commissure. Seeds of specimens collected at Zuñi smaller than others, only 1½ line in diameter.

24. O. ACANTHOCARPA, sp. nov.: caule arborescente erecto reticulato-lignoso, ramis adscendentibus divaricatis articulis cylindricis tuberculatis pallide virescentibus, tuberculis oblongo-linearibus pulvillis ovato-orbiculatis breviter tomentosis vix setosis, aculeis numerosis s. plurimis (8–25) stramineo-vaginatis undique porrectis, stellatis; bacca subglobosa late umbilicata tuberculata; pulvillis 12–15 tomentosis parce setosis aculeolis validis 8–10 munitis; seminibus magnis multangulis late commissuratis. (Plate XVIII. figs. 1–3.)

On the mountains of Cactus Pass, about 500 miles west of Santa Fé. Stout; stem 5–6 feet high, wood forming a hollow reticulated tube, solid at base; branches few, never verticillate, separating at acute angles. Joints 4–6 inches long, 1 inch in diameter; tubercles 9–10 lines long; pulvilli, in some with 1 central and 6 or 8 exterior spines, in others with 3–7 interior and 10–20 exterior stellately radiating spines. Central spines 1–1¼ inch, exterior 4–10 lines long, with a yellowish or brownish sheath. Fruit 1 inch long, with a large but not deep umbilicus and 12–15 rather shallow tubercles; spines of fruit stout, 3–6 lines long, stouter and more crowded toward the top of the fruit. Seeds unlike any other of our Opuntiæ, 2½–3 lines in diameter, with rather broad commissure, often spongy on the margin, and on the sides with many even or concave faces separated by sharp ridges.

This peculiar species cannot be confounded with any other, but comes, in the arrangement of spines, [52] nearest to *O. arborescens*, from which it is easily distinguished by its manner of growth, its elongated tubercles, and especially the much less tuberculated and spiny fruit and the peculiar seed.

25. O. TESSELATA, Engelm.: caule frutescente erecto s. diffuso, dense lignoso, ramosissimo, ramis divaricatis, articulis gracilibus teretibus, plano-tuberculatis cæsiis, tuberculis 5–6 angulatis confertissimis depressis, planiusculis; pulvillo lineari tomentoso vix setis paucis deciduis instructo, inermi s. medio s. versus basin aculeo elongato porrecto s. subdeflexo albido flavido s. fulvo vagina laxi basi constricta flava s. e flavo fulva indusiato, singulo s. rarissime binis; aculeis paucis brevibus setaceis infra sæpe adjectis; floris purpurei ovario obovato s. clavato pulvillis 30–50 villoso-tomentosis inermibus s. parce aculeolatis dense stipato; sepalis tubi sub-8 obovato-orbiculatis cuspidatis petalis 5 late obovato-orbiculatis emarginatis; filamentis exterioribus latioribus persistentibus, stigmatibus 5 brevibus ovatis adpressis; bacca ovata basi apiceque contracta sicca pulvillis villosis aculeo-latissimis confertissimis stipata, floris rudimentis coronata; seminibus subregularibus margine spongioso crasso parum prominente cinctis. *O. ramosissima*, E. in Sillim. Journ. November, 1852. (Plate XXI. figs. 1–7.)

Valley of the lower Colorado, and from thence to the California mountains. First discovered by Dr. Parry in the Colorado desert; afterwards found by Dr. Bigelow from the valley of Williams's River to 70 miles east of Cajon Pass, in the California mountains. The flower was first noticed by Mr. A. Schott, in western Sonora, toward the lower Colorado. Flowers May to September. Stems 2–6 feet high, mostly branching from the base below, 1–3 inches in diameter, covered with a dark-gray scaly bark; wood of young branches reticulate, very soon becoming solid, but even then the reticulated structure remains visible in the different layers of wood. Annual layers not as distinct as the medullary rays, but more so than in *O. frutescens;* in a stem of near 2 inches diameter we counted 35 annual layers, 8 or 9 of which belong to the alburnum. Branches numerous and slender, of an ashy or grayish-green color; younger ones 3 or 3½ lines in diameter, well characterized by the remarkable flattened tubercles, which, by closely crowding together, become 5 or 6 angular, diamond-shaped. The areola is linear, extending down to the middle of the tubercle; its short tomentum usually extends upwards between the next adjoining tubercles. Tubercles 2½–3 lines long, and a little less in diameter. Spines 1½–2 inches long, usually from the middle or at least above the base of the pulvillus, generally only on the upper tubercles of each year's growth, which gives the whole plant a singular appearance, showing the fasciculate spines at some, and having no spines at all on other parts of the apparently homogeneous branches; sheath contracted at base, and firmly adhering to the spine, loose and saccate above; small bristly spines at the base of the pulvillus, 2–3 sometimes even 5 in number, 1–4 lines long. Flower purple, about 6 lines in diameter, lowest part of the tube naked. Fruit 9–10 lines long, resembling much the fruit of the *Clavate Opuntiæ* in shape, being contracted above, with a narrow and deep umbilicus, and retaining the dead remains of the flower, of which the broad, scale-like exterior filaments are most conspicuous; pulvilli large and woolly, almost entirely covering the fruit, and beset with 30 to 50 reddish-brown, bristly, flexuous spines, 2–3 lines long. Seeds few, regular, nearly or quite 2 lines in diameter.

26. O. VAGINATA, Engelm.: caule frutescente erecto dense lignoso, ramis virgatis demum teretibus junioribus tubercula oblongo-elongata subprominentia gerentibus læte viridibus; foliis subulatis pulvillis orbiculatis magnis

breviter albo-tomentosis, setarum straminearum penicilla paro brevi, aculeis ex imo pulvillo singulis elongatis corneis s. fuscis laxe stramineo s. aurantiaco-vaginatis, adjectis subinde supra aculeis minoribus 1–2; bacca ovata tuberculata pulposa flava pulvillos 15–20 majusculos albo-tomentosos setosos gerentibus, umbilico angusto immerso, seminibus subregularibus marginatis. (Plate XX. fig. 1.)

About Albuquerque, where Dr. Wislizenus had already collected it in 1846; apparently extending into [53] Mexico, as Dr. Gregg collected what seems to be the same species about San Luis Potosi. Shrub 3–5 feet high; lower part of stem 1–1½ inch thick, covered with scaly, light-yellowish-brown bark; older branches smooth terete, younger ones 3–4 lines in diameter, strongly tuberculated; tubercles 6–9 lines long. Leaves slender, about 3 lines long, and apparently somewhat persistent, as they are sometimes found adhering, though withered, even to fruit-bearing branches, which, of course, are over a year old; the same, though to a less extent, is sometimes seen in *O. frutescens*. Pulvilli unusually large; bristles in the young ones forming a small but distinct bunch at the upper edge of the areola, but disappearing on the older joints, — contrary to the usual occurrence, when the bristles become stouter and more numerous in older joints. Spines 1–2½ inches long, dark, with very loose and glistening sheaths; second or smaller spine sometimes lateral, but usually above the principal one, not below it, as in most others. Flower unknown. Fruit ovate, 8 or 9 lines long; the pulvilli often bear 2–5 obtuse bodies, almost hidden in the tomentum, apparently glandular, but of a fibrous structure. Seeds 12–15 in each fruit, about 2 lines or a little more in diameter; commissure broad, prominent, forming a distinct, somewhat spongy rim. (See Plate XX. fig. 1, and Plate XXIV. figs. 13–15.)

In Dr. Wislizenus's Report the long-spined form of *O. frutescens* was confounded with this species. It is possible, however, that *O. vaginata*, as described here, may be a stouter, tuberculated form of *O. frutescens*, with lighter-colored, tuberculated fruit and larger seed.

27. O. FRUTESCENS, Engelm. This well-known species was observed from Laguna Colorado, 60 miles east of the Pecos, to Williams's River, a branch of the great Colorado, always with the same characters. The bark is scaly, almost papery, with a silvery reflection; the wood shows the medullary rays very distinctly, especially 5 of them; much less the annual layers. Fruit deep scarlet, smooth, small, sometimes almost obliterated pulvilli, 5–9 lines long. Seeds 5–10, about 1½ lines in diameter, with a narrow and often acute margin. The forms collected on the expedition belong to var. *α. longispina;* the var. *β. brevispina* has been observed only in Texas and northeastern Mexico. (See Plate XX. figs. 2–5, and Plate XXIV. figs. 16–19.)

EXPLANATIONS OF THE PLATES OF CACTACEÆ.

Plate I. ECHINOCACTUS WHIPPLEI, E. & B.: fig. 1, whole plant; fig. 2, bunch of spines of the usual size; [54] fig. 3, same, uncommonly large and broad; fig. 4, same, lateral view; fig. 5, same, very young; fig. 6, seed, — *a* natural size, *b* magnified 8 diameters, *c* part of the surface still more magnified to exhibit the tuberculated appearance.

Plate II. figs. 1–2. ECHINOCACTUS POLYANCISTRUS, E. & B.: 1, upper part of a rib, with older and younger bunches of spines, the youngest one with a flower-bud in the axil; 2, one of the largest and most fully developed bunches of spines.

Figs. 3–5. ECHINOCACTUS LECONTEI, E.: 3, part of a rib, with 2 bunches of spines; 4, a single bunch of spines from another specimen; 5, seed, — *a* natural size, *b* magnified 8 diameters, *c* part of the surface still more magnified to exhibit the oval pits.

Plate III. figs. 1–2. ECHINOCACTUS WISLIZENI, E.: 1, side view of a bunch of spines; 2, seed, — *a* natural size, *b* magnified 8 diameters, *c* part of the surface still more magnified to exhibit the reticulation. This species, collected by Captain Whipple on the Gila, and common about El Paso, on the Rio Grande, has been introduced here to show those characteristics which distinguish it from the nearly allied *E. LeContei* on the foregoing plate.

Fig. 3. ECHINOCACTUS EMORYI, E.: two bunches of spines on part of a rib.

Figs. 4–6. ECHINOCACTUS POLYCEPHALUS, E. & B.: 4, part of a rib, with 3 bunches of short, stout, and straightish spines; 5, a young bunch of spines of unusual dimensions and much curved, with a woolly fruit in the axil; 6, seed, — *a* natural size, *b* magnified 8 diameters, *c* part of the surface more magnified to show the warty appearance, *d* seed after the removal of the outer integument, embryo, together with a considerable quantity of albumen in the endopleura, *e* embryo curved with accumbent cotyledons.

Plate IV. figs. 1–3. CEREUS PHŒNICEUS, E.: 1, upper part of a head bearing a flower; 2, a bunch of spines of the usual size; 3, part of a rib, with 3 bunches of spines from an uncommonly large form.

Figs. 4–5. CEREUS PHŒNICEUS, subsp. CONOIDEUS, E. & B.: 4, upper part of a head; 5, part of a rib, with 2 bunches of spines.

Figs. 6–7. CEREUS TRIGLOCHIDIATUS, E.: 6, upper part of a large head, with a flower; 7, part of a rib of another specimen, with smaller curved spines.

Fig. 8. CEREUS MOJAVENSIS, E. & B.: part of a rib, with 3 bunches of spines.

Fig. 9. CEREUS MOJAVENSIS, E. & B., var. ZUNIENSIS: part of a rib, with 2 bunches of spines.

Plate V. fig. 1. CEREUS HEXÆDRUS, E. & B.: upper part of a head.

Figs. 2–3. CEREUS GONACANTHUS, E. & B.: 2, part of a rib, with 2 bunches of spines; 3, another fascicle of spines, — the 3 bunches of spines show all a different proportion of the central and the upper radial spines.

Figs. 4–7. CEREUS ENGELMANNI, var. VARIEGATUS, E. & B.: 4 and 5, 2 bunches of spines, showing a different arrangement of central spines; 6, fruit; 7, seed, — *a* natural size, *b* magnified 8 diameters, *c* part of the surface still more magnified to show the irregular tuberculation.

Figs. 8–10. CEREUS ENGELMANNI, var. CHRYSOCENTRUS, E. & B.: 8, part of 2 ribs, with numerous spines; 9, a single bunch of spines; 10, fruit, sterile and perhaps not fully developed.

Plate VI. figs. 1–3. OPUNTIA CHLOROTICA, E. & B.: 1, joint with a flower, — the flower to be reconstructed from a withered specimen collected in January; 2, sterile and probably undeveloped fruit; 3, fragment of the bark of the lower [55] part of the plant, with several large bunches of spines.

Figs. 4–5. OPUNTIA PROCUMBENS, E. & B.: 4, part of a joint; 5, larger bunch of spines from another specimen.

Plate VII. figs. 1–2. OPUNTIA OCCIDENTALIS, E. & B.: 1, joint of the usual shape and size; 2, fruit.

Figs. 3–4. OPUNTIA ANGUSTATA, E. & B.: 3, a large and less spinous joint, with a sterile degenerate spinous fruit; 4, a smaller, more spinous joint, with a full-grown ripe fruit.

Plate VIII. fig. 1. OPUNTIA ENGELMANNI, var. CYCLODES, E. & B.: with ripe fruit.

Figs. 2–3. OPUNTIA TORTISPINA, E. & B.: 2, fragment of a joint with fewer spines and ripe fruit; 3, part of a more spiny joint.

Plate IX. figs. 1–5. OPUNTIA CAMANCHICA, E. & B.: 1, a joint with shorter and lighter-colored spines; 2, a joint with larger and darker spines; 3, fragment of a joint with more numerous and crowded spines; 4 and 5, ripe fruit of the smaller and largest size.

Figs. 6–8. OPUNTIA MOJAVENSIS, E. & B.: 6, a younger bunch of spines; 7, another from the oldest part of the plant; 8, a sterile and degenerate fruit.

Plate X. figs. 1–2. OPUNTIA VULGARIS, Mill.: 1, a young joint with leaves, — the older one has a single spine and bears a flower-bud; 2, a single leaf magnified 4 diameters. The figures of this species have been introduced to exhibit the diagnostic characters and its difference from the next species.

Figs. 3–5. OPUNTIA RAFINESQUII, E.: 3, an older joint with a flower and a bud, and a younger half-grown joint with leaves, — this represents the spinous form common in Illinois, Missouri, and Arkansas; 4, an older joint of the variety with few spines, bearing numerous fruits of different shapes, as they often occur in the same plant; 5, two leaves of different sizes magnified 4 diameters.

Plate XI. fig. 1. OPUNTIA RAFINESQUII, var. MINOR, E.: the larger joint spineless, the upper one spiny on the margin.

Figs. 2–3. OPUNTIA RAFINESQUII, var. GRANDIFLORA, E.: 2, a joint with flower; 3, fruit.

Fig. 4. OPUNTIA FUSCOATRA, E.: a joint with a young fruit just after flowering; fragment of an older, very bristly joint visible.

Plate XII. figs. 1–3. OPUNTIA CYMOCHILA, E. & B.: 1, a joint; 2, a single bunch of spines; 3, ripe fruit.

Figs. 4–6. OPUNTIA STENOCHILA, E. & B.: 4, a joint; 5 and 6, a smaller and large fruit.

Figs. 7–8. OPUNTIA FUSIFORMIS, E. & B.: 7, a joint; 8, a fruit.

Fig. 9. OPUNTIA BRACAYARTHRA, E. & B.: a whole plant, with 2 withered flowers.

Plate XIII. figs. 1–5. OPUNTIA BASILARIS, E. & B.: 1, a joint somewhat shrivelled as it appears in winter, a late young joint near its base appears more plump and fresh; 2, flower; 3, style; 4, undeveloped sterile fruit; 5, a whole plant reduced in size to show the singular manner of growth.

Figs. 6–7. OPUNTIA SPHÆROCARPA, E. & B.: joint and fruit.

Figs. 8–11. OPUNTIA ERINACEA, E. & B.: 8, joint of the usual shape (only partly finished); 9 and 10, bunches of spines; 11, fruit.

Plate XIV. figs. 1–3. OPUNTIA MISSOURIENSIS, var. RUFISPINA, E. & B.: 1, a joint (only partly completed); 2, a very full bunch of spines; 3, fruit.

Fig. 4. OPUNTIA MISSOURIENSIS, var. PLATYCARPA, E.: fruit.

Figs. 5–7. OPUNTIA MISSOURIENSIS, var. MICROSPERMA, E.: 5, joint (unfinished) with flower; 6, bunch of spines; 7, fruit.

Figs. 8–10. OPUNTIA MISSOURIENSIS, var. ALBISPINA, E. & B.: 8, joint (unfinished); 9, bunch of spines; 10, fruit.

Plate XV. figs. 1–4. OPUNTIA MISSOURIENSIS, var. TRICHOPHORA, E. & B.: 1, part of an old stem showing the [56]
thickness and hairy spines, upper younger joints (unfinished); 2, bunch of spines from a younger joint; 3, same from an older part of the plant; 4, fruit.

Figs. 5–7. OPUNTIA HYSTRICINA, E. & B.: 5, a joint (unfinished); 6, a large bunch of spines; 7, fruit.

Plate XVI. OPUNTIA DAVISII, E. & B.: 1, a branch showing the structure of the older parts, an older and young joints with two fruits; 2, a tubercle with its bunch of spines, the membranaceous sheaths partly torn, showing the spine itself; 3, a degenerate sterile spiny fruit in its transition to a branch, as it is often seen in this species and others, especially cylindric opuntia; 4, the whole plant reduced.

Plate XVII. figs. 1–4. OPUNTIA WHIPPLEI, E. & B.: 1, a branch of the more common form of the plant covered with ripe fruit, — at (*a*) the fruit is undeveloped, probably not different from the ovary of the flower, only more shrivelled; 2, branch of a larger specimen, spines more numerous, fruit larger; 3, a single bunch of spines of this specimen; 4, whole plant reduced.

Figs. 5–6. OPUNTIA ARBORESCENS, E.: 5, a stout branch, with numerous spines and large fruit; 6, a bunch of spines of same.

Plate XVIII. figs. 1–3. OPUNTIA ACANTHOCARPA, E. & B.: 1, an older branch with fruit; 2, a young branch; 3, whole plant reduced.

Fig. 4. OPUNTIA ARBORESCENS, E.: whole plant reduced.

Figs. 5–10. OPUNTIA ECHINOCARPA, E. & B.: 5, a branch of the plant densely covered with the sheathed spines; 6, 7, and 8, bunches of spines; 9, fruit, side view; 10, same, top view.

Plate XIX. OPUNTIA BIGELOVII, E.: 1, a single joint; 2 and 3, tubercles, with bunches of spines; 4, young undeveloped fruit; 5, an apparently full-grown fruit, sterile, and perhaps degenerating into a branch; 6, part of the ligneous skeleton, forming a wide tube, and showing in the reticulated structure the traces of the tubercles and branches; 7, an entire plant reduced, — on the left of the main stem is a younger shoot, with vigorous erect joints.

Plate XX. OPUNTIA VAGINATA, E.: 1, an older joint, bearing two fruits, and a young vigorous shoot.

Figs. 2–3. OPUNTIA FRUTESCENS, E., var. LONGISPINA: from Williams's River of the Colorado; 2, a branch with fruit; 3, lower part of the trunk, with some roots, — the sections show the structure of the dense wood.

Figs. 4–5. OPUNTIA FRUTESCENS, E., var. BREVISPINA: 4, a branch with fruits, most of them sterile, one producing young branches from its upper areola; 5, a flower.

Plate XXI. OPUNTIA TESSELLATA, E.: 1, a branch with fruit *a a*, and a withered flower *b*; 2 and 3, flowers as they probably are reconstructed from withered specimens; 4, a small joint magnified so as to show distinctly the appearance of the tubercles and areolæ; 5, part of the stem with a section of the wood above and a fracture below, so as plainly to show the ligneous structure, — the bark of the younger branches exhibits the tesselated surface, while in the older trunk it is lost in the irregular scales; 6, ligneous skeleton of a young branch; 7, a whole plant reduced.

Plate XXII. figs. 1–3. OPUNTIA CLAVATA, E.: 1, joint with a ripe fruit; 2, one of the upper bunches of spines; 3, part of the central spine magnified 4 diameters.

Figs. 4–7. OPUNTIA PARRYI, E.: 4, joint with ripe fruit; 5, bunch of spines, side view; 6, another one, front view; 7, part of the central spine magnified 4 diameters.

The remaining figures of this and all the two following plates represent seeds and their details of almost all the *Opuntiæ* described in this report. Fig. *a* represents a side view of the seed, natural size; *b*, same, 4 times magnified, as are all the following figures; *c*, posterior view; *d*, anterior view; *e*, vertical section of seed, exhibiting the position and proportion of the embryo and the albumen; *f*, embryo and albumen coated by the endopleura, after the removal of the testa; *g*, lateral view of embryo. The other letters, *h*, *i*, *k*, etc., will be explained wherever they occur.

Figs. 8–9. Seeds of O. ENGELMANNI, var. CYCLODES. [57]

Fig. 10. Seed of O. OCCIDENTALIS: one of the embryos, *g*, shows the cotyledons in an oblique, almost incumbent position.

Fig. 11. Seed of O. ANGUSTATA.

Figs. 12–15. Seeds of O. CAMANCHICA, of different sizes and shapes.

Plate XXIII. figs. 1–5. Seeds of O. TORTISPINA: 1–3, seeds of different sizes and shapes; 4, two embryos in one seed; *g–h* different views of both embryos together as they lay in the seed, *i* interior layer, and *k* exterior smaller embryo; 5, germination of a double embryo, — two young plants from one seed, the larger one still bearing the shell of the seed.

Fig. 6. Seed of O. FUSIFORMIS.

Figs. 7–12. Seeds of O. RAFINESQUII, and some of its varieties and sub-species: 7, usual form from Missouri (see Plate X. fig. 3), *h i k* germination in different stages of development, *l* seedling with three cotyledons.

Fig. 8. Small seed from the fruit (represented on Plate X. fig. 4).

Fig. 9. O. STENOCHILA.

Figs. 10–12. O. CYMOCHILA: 10 and 11, different forms of the usual variety; 12, seed of the variety *montana*.

Fig. 13. Seed of O. VULGARIS.

Fig. 14. Seeds of O. BASILARIS : an irregular and a very regular one from the same fruit.

Fig. 15. Seed of O. HYSTRICINA.

Figs. 16–19. Seeds of different forms of O. MISSOURIENSIS ; 16, var. RUFISPINA ; 17, var. PLATYCARPA, *h* seedling of same ; 18, var. ALBISPINA ; 19, var. TRICOPHORA.

Plate XXIV. figs. 1–2. O. MISSOURIENSIS : 1, var. with smaller fruit and seeds from the upper Missouri ; 2, var. MICROSPERMA. (See Plate XIV. figs. 5–7.)

Fig. 3. Seed of O. SPHÆROCARPA.

Fig. 4. Seed of O. ERINACEA : the embryo *g* shows considerable obliquity of the cotyledons.

Fig. 5. Seed of O. FRAGILIS : from the Yellowstone River.

Fig. 6. Seed of O. CLAVATA : the embryo *g* oblique.

Fig. 7. Seed of O. PARRYI : embryo *g* nearly accumbent.

Fig. 8. Seed of O. ECHINOCARPA : one of the seeds quite regular, the other irregular ; embryo *g g* always regularly accumbent ; *h* and *i* seedlings with the very narrow and thick cotyledons crossing each other, one of them bearing the shell of the seed.

Figs. 9–10. Seeds of O. WHIPPLEI : 9, seed of the plant represented in Plate XVII. fig. 2, seed larger, commissure perfectly linear, cotyledons oblique ; 10, seeds of the other specimen, Plate XXII. fig. 1, seeds smaller, of different shapes, commissure a little wider, cotyledons oblique, in *i* somewhat separated, in *k* three cotyledons, of which *l* is a transverse section, *h* seedling with very narrow and long cotyledons.

Fig. 11. Seeds of O. ACANTHOCARPA, of different shapes, all from one fruit.

Fig. 12. Seeds of O. ARBORESCENS, of different shapes, belonging to the plant figured Plate XVII. fig. 5, smaller than those sent by other collectors, embryo *g* regularly incumbent.

Figs. 13–15. Seeds of O. VAGINATA : 13, 14, seeds of different sizes, from the plant Plate XX. fig. 1, — the smaller one is empty, and perhaps not fully formed ; 15, seed of the same species, collected in Mexico by Dr. Gregg. Cotyledons regularly incumbent.

Figs. 16–19. Seeds of O. FRUTESCENS : 16, var. LONGISPINA, from the Llano Estacado (Plate XX. fig. 2) ; 17, same from Mexico, Dr. Gregg ; 18, same from Williams's River, branch of the great Colorado ; 19, var. BREVISPINA, from Texas, Lindheimer. In all these the cotyledons of the embryo are regularly incumbent.

Fig. 20. Seeds of O. TESSELATA : embryo oblique or almost accumbent.

All the figures are of natural size unless the contrary is expressly stated. They were drawn with the greatest accuracy, partly from living and in part from dried specimens, by Mr. Paulus Roetter, of St. Louis, under the personal [58] superintendence of Dr. Engelmann. The drawings made on the spot by Mr. H. B. Möllhausen, the artist of the expedition, greatly aided the work, and were made use of, and even partly copied, especially in the plates exhibiting the Cylindric Opuntiæ.

VIII. — CACTACEÆ OF THE BOUNDARY.

FROM REPORT OF THE UNITED STATES AND MEXICAN BOUNDARY SURVEY, UNDER THE ORDER OF LIEUT.-COL. W. H. EMORY, MAJOR FIRST CAVALRY, AND UNITED STATES COMMISSIONER. II. PART I. pp. 1–78. Washington, 1859.

I. MAMILLARIA, HAW.[1]

Subgen. 1. EUMAMILLARIA.

[3]

Plantæ simplices seu cæspitosæ, tuberculatæ, aculeigeræ.

Tubercula plus minus teretia seu angulata, nunquam sulcata.

Areolæ floriferæ axillares, ab areolis aculeiferis penitus distinctæ, nudæ seu villosæ, nunc setosæ.

Flores ex axillis tuberculorum anni prioris antecedentiumve orti, plerumque parvi inconspicui.

Ovarium plerumque immersum : bacca versus maturitatem solum (anno secundo in plurimis) emergens, fere semper clavata, coccinea.

[1] I leave the character of the genus, as heretofore, generally circumscribed. Lemaire's genus *Anhalonium*, however, — a species of which is found in our territory, — in my opinion, cannot be separated from *Mamillaria* so long as the generic character is founded on the organs of fructification, and not on the external shape of the plants. The expression "Inflorescentia verticalis," which I use in relation to the subgenera *Coryphantha* and *Anhalonium* and to the genus *Echinocactus*, although in common use, is not strictly correct. The flowers appear on the vertex of the plant, indeed, but not as the prolongation of the main axis. They are, as in all Cactaceæ, properly lateral, but produced by the young growth of the same year, while in all other Cactaceæ they spring from the growth of the preceding or former years ; and consequently make their appearance more or less on the side of the plant, or, if on the top, only on older branches or joints.

Semina minuta, plerumque rugulosa seu scrobiculata, rarissime verruculosa, vix lævia, fulva, fusca, seu nigra.

Most *Mamillariæ* heretofore known and cultivated belong to this subgenus, which is well characterized by the lateral position of the flowers.

1. M. MICROMERIS, sp. nov.: parvula, simplex, globosa, vertice depresso; tuberculis minimis verrucæformibus confertissimis; areolis solum junioribus lana laxa longa vestitis; aculeis plurimis pluriserialibus minutis ex albido cinereis, in plantis junioribus et in tuberculis inferioribus plantarum adultarum sub-20 æqualibus lineam longis radiantibus, in tuberculis floriferis (verticem plantæ adultæ versus) 30–40 stellato-porrectis, superioribus 6–8 cæteros bis terve superantibus versus apicem clavatis acutis, parte superiore demum deciduo; floribus minimis subcentralibus; sepalis petalisque 5; stigmatibus 3 stamina æquantibus; bacca elongata clavata coccinea floris rudimenta dejiciente; seminibus paucis oblique obovatis basi acutis nigris lucidis sub lente levissime verruculosis, hilo elongato ventrali.[2] (Tab. I. and II. fig. 1–4.)

Var. β. GREGGII: major, tuberculis globoso-ovatis paullo majoribus; aculeis rigidis 2–3 seriatis, interioribus [4] 5–7 brevioribus robustioribus, exterioribus 15–18 paullo longioribus, omnibus radiantibus; seminibus paullo minoribus leviter verrucosis. (Plate II. figs. 5–8.)

From El Paso to the San Pedro River; also in a single locality east of this river; in naked places on mountain tops or sides, only on limestone, never in the porphyritic region: C. Wright. Var β. was collected by the late Dr. J. Gregg on a mountain ridge between Azufrora and Penos Bravos, near Saltillo, Mexico. — Small globose plants, depressed at top, simple, or very rarely (and probably only after an injury to the top of the main plant) branching. Heads usually ½ to 1 inch in diameter; in largest specimens seen 15–18 lines in diameter. Plants densely covered by the delicate ashy-gray spines. Tubercles about ½ line long, only 1–1¼ lines distant from one another, older ones shedding the spines, and giving the base of the plant a very pretty tuberculated appearance; in the larger plants 21 or 34 spiral rows of the tubercles are the most distinct. Spines not pungent in several series, usually about 1 line long; on the younger tubercles of the fully-developed plant (those, I suppose, which may bear flowers in their axils) the 6–8 upper exterior spines are 2–3 or sometimes even 4 times as long as the other spines (2–4 lines long), thickened or clavate toward the end, with an acute point. These spines are the first to appear in the nascent tubercle (as indeed is the case in all *Mamillariæ* where the uppermost radial spines are always developed before the others), mixed with loose wool of almost the same length. These elongated superior spines form a small tuft in the vertex of the plant, which includes and partly hides the flowers and fruit. When they get older, apparently after the second or third year, the upper part of these long spines breaks off, leaving them of the same length as the others, but always distinguishable by their ragged end. These peculiar spines, of which I have not seen any analogy in other species, are wanting in younger plants.

The position of the flowers in this plant is rather a doubtful one. I have not seen living specimens in flower; but the structure of the tuft, the position of the berries in the dead specimens before me, and the note of Mr. Wright, "flowers central," would seem to indicate that they really appear in the new growth of the same season. In that case this species would be an anomalous small-flowered and small-tubercled *Coryphantha*. But I am yet inclined to consider the flowers as only *nearly central*, and borne in the axils of the last tubercles of the preceding season; all the analogies, at least, are in favor of our plant being a true *Mamillaria*. Flowers reduced to the simplest type of *Cactaceæ*, namely, — 3–5 sepals, about 5 petals, two or three times as many stamens, and a style with 3 stigmata; diameter of flower about 3 lines; petals whitish or very light pink. Fruit an elongated clavate red and somewhat juicy berry, 4–6 lines in length, without the remains of the flower on top, somewhat persistent on the plant, finally shrivelling up; obovate, grey, and hid in the tuft: so it is found in the specimens brought home. Seeds only 6–12 in

[2] I look at the seed always in such a position that the radicle of the embryo points downward and the cotyledons upward, or, when curved, upward and forward to the left. All the seeds figured in this Report are represented in this position, unless otherwise stated. We have then one *side* or *face* (produced by the always more or less distinct compression of the seed) toward the beholder, the *base* below, and the *ventral* part or edge of the seed to the left, and the *dorsal* part to the right.

The hilum is large or small, circular, oblong, oval, or elongated, mostly more or less basal, but not rarely subventral or ventral. It is usually surrounded by a tumid rim, formed by the thickened testa, smoother than the other parts of the seed. The albumen, when present, or the trace of it, — which is indicated by a never-wanting thickening of the endopleura, — is always found on the ventral part of the seed. The back or dorsal part of the seed is often more or less carinate, especially toward the base. The testa of the seed is pergamentaceous, yellowish or brownish or black; or it is hard, crustaceous, and then always black; or it is whitish, and thick and bony (only in *Opuntiæ*). The surface of the seed is smooth, often shining; or it is rugose, or pitted, or covered with very minute or larger warts or tubercles. These tubercles are distinct, or more or less concatenate or confluent, leaving irregular pits in their interstices. Smooth or pitted seeds I find in most *Mamillariæ* and *Echinocacti;* irregularly rugose ones in some *Echinocacti* and *Cerei;* tuberculated seeds only in *Anhalonium*, the single *Echinocactus setispinus*, and all *Echinocerei;* while the species of the other sections of *Cereus* known in our Flora generally have smooth seeds. Of the quite peculiar, large, flat, and bony seeds of *Opuntiæ*, I shall find occasion to speak hereafter.

each fruit, comparatively large, 0.7 line long, 0.5 in diameter, with a very large umbilicus; testa hard and brittle, though thin.

Var. *Greggii* is larger and coarser in all its parts. The specimens before me are 1–2 inches in diameter; tubercles 1–1¼ line long; exterior spines 1½–2 lines, interior stouter ones ½–1 line long. The 6–9 upper elongated spines on the younger tubercles are 3–4 lines long, thicker at base, very slender in the middle, and thickened [5] again toward the very acute point. Fruit about 9 lines long. Seed smaller than in the more northern form, 0.6 line in length, and more distinctly tuberculated.

Mamillaria microthele, Muhlenpf., seems to be closely allied to our plant, but is distinguished (to judge from the descriptions) by its cespitose growth, and its distinct 1 or 2 central spines. No allusion is made in the descriptions to the remarkable vertical tuft, though the small pale rose-colored flowers are mentioned. The name, *M. micromeris*, refers to the smallness of all the parts of this species.

2. M. LASIACANTHA, sp. nov.: parvula, simplex, globosa seu ovato-globosa; tuberculis cylindricis læte viridibus; axillis nudis; areolis junioribus albido-lanatis; aculeis 40–80 pluriseriatis omnibus radiantibus maxime inæqualibus brevibus setiformibus albis rectis seu paullo recurvatis ciliato-pilosulis vel denudatis; floribus lateralibus parvis; sepalis 13 obtusis, exterioribus mucronatis; petalis 13 fere uniseriatis oblongis obtusis emarginatisve; stylo stamina brevia longe superante; stigmatibus 4–5 ovatis brevibus erectis convergentibus; bacca elongata clavata coccinea; seminibus numerosis obovato-subglobosis scrobiculatis nigricantibus, hilo basilari ovali.

Var. *a.* MINOR: caule minore ovato; aculeis paucioribus brevioribus dense pilosulis. (Tab. III.)

Var. *β.* DENUDATA: caule majore globoso; aculeis plurimis longioribus subnudis. (Tab. IV.)

About Leon Spring and Camanche Spring, west of the Pecos, on low limestone hills, among herbage; C. Wright. Flowers April and May. — A pretty little species, covered with and almost entirely hidden under the innumerable soft, more or less pubescent spines. The smaller form is 9–12 lines high and 6–9 lines in diameter; tubercles in 8 or 13 spiral rows, 2 lines long and nearly 1 line in diameter; areolæ 1½ line distant from one another; spines 40–60, 1½–2 lines long, the upper exterior ones a little longer than the rest, the innermost ones often not half as long as the others. The larger form, var. *β.*, is 1–1½ inch high, and of almost the same diameter; tubercles 2½–3 lines long, in 13 or 21 spiral rows; spines 50–80, almost or the old ones entirely naked, 1½–2½ lines long, the innermost usually much shorter. The flower is half an inch long, and when fully open of the same diameter; petals white, with a red streak in the centre, which at base forms a red circle around the yellow stamens; style yellowish, with 4 or 5 yellowish-green stigmata, which form together a short globose head. Fresh fruit 6–10 lines long, without the remains of the flower, somewhat persistent and finally shrivelled up, greyish, obovate-clavate, deeply imbedded and hid between the tubercles. Seeds 10–25 in each fruit, smaller than in the last species, and altogether different in shape and surface, about 0.5 line long, very conspicuously pitted, hard and brittle. I have named this species *M. lasiacantha*, from the usually very soft pubescence of the spines. It is evidently closely allied to *M. Schiedeana*, Ehrenb.; but this is a much larger plant, with larger tubercles, very woolly axils, and its spines forming a silky brush. Both this and the last species belong to Prince Salm's § 3, *Polyacanthæ* * * *aculeis patentissimis adpressis.* The position of the flower, however, seems to indicate that they are widely separated from each other, though the external appearance of the plants is very much alike.

3. M. PUSILLA, DC., var. TEXANA: ovato-globosa, prolifera, cæspitosa; tuberculis teretibus versus apicem conicis, axilla longe-lanatis setosisque; aculeis pluriseriatis, extimis numerosissimis (30–50) capillaceis elongatis flexuosis vel crispatis albis, interioribus 10–12 sensim rigidioribus brevioribus rectiusculis puberulis albidis, [6] intimis 5–8 longioribus rigidis rectis pubescentibus basi bulbosis infra albidis sursum rufis fuscisve inæqualibus; florum lateralium ovario subemerso; sepalis 9–12 oblongo-linearibus obtusiusculis tenuiter fimbriatis; petalis 13–16 fere uniseriatis oblongo-linearibus obtusis vel emarginatis sæpe mucronatis; stigmatibus 5 flavidis longe supra stamina exsertis; bacca elongata clavata s. sub-cylindrica coccinea floris rudimentis involutis coronata; seminibus plurimis obovatis scrobiculatis nigris lucidis, hilo basilari lineari. (Tab. V.)

From Eagle Pass to Santa Rosa, Dr. Bigelow; and, according to Dr. Poselger, common on the Rio Grande below. Flowers March to May. — Heads 1–1½ inch in diameter, 1–2½ inches high, usually covered below with young branches, and finally densely cespitose; tubercles 3½–4½ lines long, dark-green; axillæ quite woolly, with several coarse twisted bristles mixed with the wool. Exterior hair-like spines covering the whole plant as with a coarse wool, often 6–8 lines long when straightened; interior spines slender, but stiff and pointed, 3–4 lines long, in young or weakly specimens whitish, with dark tips, in robust ones yellow at base, brown upwards, and almost black at tip. Flowers 7–10 lines long; petals dirty yellowish-white, with a reddish streak in the middle. Fruit about 9 lines long. Seeds 0.6 line long, hard and brittle, very similar to the seed of the last-mentioned species, only a little larger and with narrow hilum.

M. pusilla, from the West Indies, is so near our plant that this one must necessarily be referred to it. The only difference seems to consist in the smaller number of radial spines (12–20) in *M. pusilla*, and in the greyish-green color of its tubercles.

4. M. PHELLOSPERMA (*M. tetrancistra*, E. partim in Sillim. Journ. Nov. 1852) : ovata seu ovato-cylindrica, simplex seu rarius e basi ramosa; tuberculis ovato-cylindricis; axillis lanatis setigeris demum nudis; aculeis radialibus numerosissimis (40–60) biseriatis, exterioribus tenuioribus brevioribus albis, interioribus robustioribus longioribus apice fuscatis, centralibus 3–4 robustioribus longioribus ex basi pallidiore atrofuscis, superioribus 2–3 rectis seu uno alterove hamatis, inferiore validiore sursum hamato; floribus versus plantæ apicem lateralibus; sepalis 15–17, exterioribus ovatis obtusiusculis ciliatis, interioribus oblongo-linearibus; petalis sub-12 acuminato-aristatis; stigmatibus 5; bacca obovato-clavata late umbilicata corollam marcescentem dejiciente tenui coccinea vix pulposa; seminibus magnis globosis rugosis, ad hilum massa suberosa semine ipso majore triloba fusca arilliformi auctis. (Tab. VII.)

Dry gravelly hills about the base of the mountains east of the Californian Cordilleras, near San Felipe, Dr. Parry; also on the lower Gila, Dr. Le Conte, A. Schott; on the lower Colorado, the Mojave, and east of the Colorado toward the Cactus Pass, Dr. Bigelow. — This interesting species was first noticed by Dr. Parry, and was described from his notes in Silliman's Journal, l. c., under the name of *M. tetrancistra*. Specimens brought home since by several collectors leave no doubt that this and several other species had been confounded; and, moreover, that hardly ever all the four central spines are hooked. The original name had therefore to be altered; the one selected for it indicates the peculiar corky structure of the enlarged base of the seed.

Our species is often simple; not rarely several stems are seen coming from one base, or an older stem bears young branches at its lower part. Young stems almost globose; older ones ovate, and even cylindric, 2 to 4 or 5 inches high, 1½ or 2 inches in diameter. Tubercles 4–7 lines long; not so much crowded as in the allied species, in 8 or at most 13 spiral rows. The axils of the young tubercles produce loose wool, with a few long spiny bristles, which disappear only after several years. In the smallest specimen before me I find 14–18 exterior radial spines 4–5 lines long, and 12–16 interior ones 5–6 lines long; in other specimens I have counted from 50–60 radial spines. The upper [7] central spines in my specimens are mostly 5–7 lines long; sometimes I find 1 or 2 of them longer and hooked, and sometimes all 4 are said to be regularly hooked; the lower central spine is stouter and longer than the others, 6–9 lines long, with the sharp hook always turned upwards. Flower apparently about an inch long; fruit clavate or pear-shaped, 6–12 lines long and 4–6 lines in diameter, with a thin scarlet-colored integument, torulose from the protrusion of the large seeds; the withered flower falling off leaves a wide circular umbilicus. Seeds large, visible through the thin pericarp, attached to conspicuous white funiculi; seed proper 0.6 or 0.7 line in diameter, with the appendage 1.2–1.5 line long; the curious spongy or corky appendage is larger than the seed itself, and buries its lower part, as it were, in a bluntly 3-lobed cup. Embryo almost globose, 0.6 line long, 0.5 line in diameter; cotyledons small, but perfectly distinct and visible; no albumen.

Apparently near *M. ancistroides*, Lem., with 30–40 radial and 4–5 central spines; flower and fruit unknown. The radial spines are said to be homogeneous and the axils naked.

5. M. GRAHAMI, sp. nov.: globosa seu demum ovata, simplex seu e basi ramosa; tuberculis ovatis basi dilatatis; axillis nudis; areolis orbiculatis seu ovato-orbiculatis; aculeis radialibus uniseriatis 15–30 albis sæpe apice fuscatis nudis seu puberulis, summis brevioribus, lateralibus longioribus; aculeo centrali singulo robustiore longiore sursum hamato, sæpe 2 rectis sursum divergentibus adjectis, omnibus e basi pallidiore fusco-atris; floribus sub vertice lateralibus rubicundis; sepalis sub-13 lineari-oblongis obtusiusculis ciliolatis; petalis sub-13 lineari-oblongis roseatis, exterioribus mucronatis, interioribus obtusis retusisve; stylo stamina brevia longe superante; stigmatibus 6–8 elongatis filiformibus suberectis; bacca ovata (viridi?) floris rudimentis coronata; seminibus oblique obovatis scrobiculatis nigris. (Tab. VI. fig. 1–8.)

Mountainous regions from El Paso, Charles Wright; southward and westward to the Gila, Dr. Parry; and Colorado, A. Schott; and up this latter river as far as Williams's River and Cactus Pass, Dr. Bigelow. Flowers from June or July to August. — Stems 1–3 inches high, 1–2½ inches in diameter, simple or somewhat branching from the base, and thereby sometimes slightly cespitose. Tubercles 3 lines long, and when old of a corky texture; persistent when dead and dry, like those of *M. tuberculosa;* disposed in 13 or 21 spiral rows. Radial spines in some smaller specimens 25–30, in larger ones often only 20–25, and in some Sonora specimens only 15–18 in number; the lateral ones are the longest, about 3–4 lines, or in the largest specimens even 5–6 lines long; lower spines shorter, upper ones the shortest and most slender. In smaller specimens only 1 central spine is observed, generally much longer than the radial spines, 3–9 lines long, with a wide or sometimes a narrower hook, always curved upward; in many specimens one or two upper spines are found, neither so stout nor so long as the lower hooked one, and always straight. Flower 9–12 lines long, rose-colored. Fruit a small oval berry, about half an inch long, apparently green when ripe. Seeds among the smallest in this genus, only 0.4 or rarely 0.5 line long, slightly pitted, with a small and narrow hilum.

This pretty species has been named for Colonel J. D Graham, of the United States Corps of Topographical Engineers, under whose auspices many of these species were collected.

6. M. WRIGHTII, sp. nov.: globosa seu depresso-globosa, basi obconica, simplex; tuberculis teretibus; axillis

nudis; aculeis radialibus sub-12 albidis summis 3–5 paullo robustioribus apice fuscatis, lateralibus sublongioribus, inferioribus gracilioribus; aculeis centralibus plerumque binis divergentibus uncinatis fusco-atris radiales subæquantibus; floribus lateralibus (?); sepalis exterioribus 13 triangularibus obtusiusculis fimbriatis, interioribus 8 acutis margine petaloideis; petalis 12 lineari-lanceolatis acuminatis aristatis purpureis; bacca majuscula ovato- [8]
globosa succosa purpurascente floris rudimentis coronata; seminibus obovatis basi acutis nigris scrobiculatis, hilo subventrali parvo angusto. (Tab. VIII. fig. 1–8.)

New Mexico, near the Coppermines, Wright; near El Paso, Parry; and on the upper Pecos, east of Santa Fé, Bigelow. — Stems 1½–3 inches in diameter, hemispherical above, flattened or depressed in the centre, and top-shaped below; simple, as all the *Mamillariæ* of that form usually are. Tubercles 5–6 lines long. Spines 4–6 lines in length, shorter in the southwestern, longer in the northeastern specimens; uppermost radial spine stouter than the others, with a brown tip, or smaller and slender, or entirely wanting; central spines usually 2 side by side, diverging laterally or rarely one above the other, — sometimes only 1, or not seldom 3, the third one being below the two others; the hooks usually turned downward or in different directions. The flowers seem to be lateral, but very near the vertex; the fruit is moved more outward by the continuous growth of the plant; flower about an inch long and fully as wide; petals and margin of inner sepals bright purple. Berry large, nearly an inch long, purplish. Seed similar to that of *M. Grahami*, but much larger, and the very small and narrow hilum ventral; length of seed 0.7 line.

This species I with pleasure dedicate to my friend Mr. Charles Wright, to whose indefatigable exertions botany owes so many new discoveries along the Mexican boundary line, and lately in more distant parts of the globe.

7. M. Goodridgii, Scheer: globosa seu ovata, subsimplex; vertice tomentoso; tuberculis ovatis abbreviatis; axillis junioribus lanatis setigeris demum nudatis; aculeis radialibus 11–15 (plerumque 12–13) albidis apice sphacelatis intertextis, centralibus 3–4 (in plantis junioribus subsingulis) fusco-atris, superioribus divergentibus rectis seu rarissime subuncinatis, inferiore paullo longiore robustiore sursum hamato; floribus in vertice lateralibus parvis; petalis lanceolatis acuminatis sordide flavidulis medio rubellis; stigmatibus 3 virescentibus. (Tab. VIII. fig. 9–14.)

Dry ravines near San Diego, California, Dr. Parry; originally brought to England from the Island of Cerro, on the California coast. — One of the specimens of Dr. Parry, from which the above description was drawn, is 2 inches high and 1½ inch in diameter; the other is globose and rather depressed. The tubercles are 1½–2½ lines long, and of a somewhat corky texture, like those of *M. Grahami*, so that the dead ones retain their shape and do not shrivel up. The axils produce a very dense wood, and in it 5–8 stiff bristles, which often reach the length of the tubercle. The radial spines are 2½–3½ lines long, the uppermost one present or wanting; the upper central spines, 2 or 3 in number, are straight, or rarely, in my specimens, with a tendency to form a hook; the lower central spine is the longest one, 4½–5 lines long, — the narrow or rarely wide hook is turned upward or sidewise. Flowers 6–9 lines long, 6 lines wide, dirty-yellowish; the petals with red midribs.

8. M. Heyderi, Muhlenpf. — of which my *M. applanata* (Tab. IX. fig. 4–14) and *M. hemisphærica* (Tab. IX. fig. 15–17), published in "Plantæ Lindheimerianæ," are different forms — is common throughout the southern parts of New Mexico, and may even extend into Sonora, according to Mr. Schott's notes, unless what he has seen is a form of *M. gummifera* (Tab. IX. fig. 18–20), brought by Dr. Wislizenus from the mountains west of Chihuahua. The Sonora plant is stated to have 13 radial spines; the inferior ones are 6–8 lines and the superior ones 2–3 lines long; the stout central spine is of the length of the latter.

9. M. meiacantha, sp. nov.: simplex, hemisphærica seu vertice depressa, basi obconica, lactiflua; tuber- [9]
culis pyramidato-quadrangulatis compressis basi productis axilla nudis; areolis junioribus albido-villosis mox nudatis; aculeis paucis (5–9) rigidis rectis vel recurvatis albidis seu flavidis (demum cinereis) apice sphacelatis, inferioribus paullo longioribus, centrali singulo robusto breviore porrecto seu sursum flexo et cum cæteris radiante seu rarius nullo; floribus sordide albidis rubellisque; ovario nudo; sepalis 12–14 lanceolatis; petalis 14–16 linearilanceolatis acutis subintegris; stigmatibus 6–7 stamina brevia vix excedentibus flavidulis; bacca elongato-clavata incurva floris rudimenta dejiciente; seminibus minutis obovatis regulosis fulvis. (Tab. IX. fig. 1–3.)

Throughout New Mexico, from where it was first brought home by the Missouri Volunteers in 1847; often collected since by the different explorers of the botany of those regions. Flowers May and June. — Very nearly allied to the foregoing species; distinguished by the fewer, more loosely arranged tubercles, — which rise from a much broader base, — and by the fewer, shorter, and stouter spines. Plants 3–5 inches in diameter, with a broad, top-shaped base, terminating in the large fleshy root; tubercles 7–9 lines long, strongly quadrangular, somewhat compressed from above, arranged in 13 spiral rows. Spines, as indicated by the name, fewer than in the allied species, — 5–9, usually about 6, lowest ones mostly a little longer than the lateral ones, 3–5 lines long, stout, and strongly subulate, often curved in different directions; upper spine wanting or often replaced by the stouter and a little shorter central spine, which is then turned upward; spines in robust specimens dirty-yellowish with brown points, central one darker than the rest, — in young and weakly specimens they are whitish. Flowers 12–14 lines long, somewhat ureeolate. Exterior petals longest, entire; interior ones a little shorter, entire or slightly denticulate; all whitish, with a broad rose-

colored line in the centre. The ovary does not exude the milky fluid which the tubercles and other parts of the plant contain. Fruit ripening the second spring and summer, till then hidden between the bases of the surrounding tubercles, and for the greater part buried in the tissue of the plant; in spring the young fruit suddenly (in one or two weeks) grows to its full size, 9–12 or even 15 lines long, protruding far above the tubercles, and forming an exterior scarlet circle around the inner circle of rose-colored flowers. Seeds 0.5 line long, subglobose-obovate, with a narrow sub-basilar hilum, yellowish-brown, rugose, and somewhat pitted.

10. M. SPHÆRICA, Dietrich: e radice crassa obovata seu clavata, prolifera et demum densissime cæspitosa; tuberculis ovato-elongatis versus apicem acutatum conicis, axilla lanatis; areolis junioribus breviter tomentellis; aculeis setaceis basi bulbosis rectis seu curvatis albidis, radialibus 12–14, centrali singulo recto subulato subbreviore vix robustiore; flore subverticali magno flavo; tubo supra ovarium emersum constricto elongato; petalis sub-18 acuminatis aristatis integris; stigmatibus 8 linearibus patulis.

Hillsides on the Rio Grande, near Eagle Pass; Schott. Flowers from March throughout the season. — Dr. Poselger's specimens were collected at Corpus Christi, on the coast of Texas. Dietrich's description, taken from them, well agrees with Mr. Schott's plants and with specimens now frequently cultivated at St. Louis, from both of which the above character is drawn. — This species is remarkable on account of its exsert ovary and large flower, by which characters it closely approaches to the next subgenus; but the flowers, though apparently nearly vertical, come from last year's growth. Specimens before me are 2 inches high, $1\frac{3}{4}$ inch in diameter above, narrowed below, the old tubercles withering, and leaving a short clavate scaly stem. The tubercles soon become proliferous, and the [10] branches increase and reproduce often in such a manner as to form large and dense hemispherical masses. Tubercles 6–8 lines long; spines $3\frac{1}{2}$–$4\frac{1}{2}$ lines long. Flowers $1\frac{1}{2}$–2 inches in length, and fully as widely open in bright sunshine; tube slender, funnel-shaped, remarkably constricted above the oval ovary. Fruit not seen.

Subgen. 2. CORYPHANTHA.

Plantæ simplices seu cæspitosæ, tuberculatæ, aculeigeræ.

Tubercula plus minus teretia, florifera facie superiore longitudinaliter sulcata, in stirpibus junioribus nondum floribundis sulco breviori notata, vel penitus esulcata.

Areolæ floriferæ axillares seu in tuberculo ipso supra-axillares, cum areolis aculeiferis sulco villoso plus minus profundo demum nudato subinde glandulifero junctæ, tomentosæ.

Flores ex areolis tuberculorum hornotinorum adultorum (inde laxi) seu vix evolutorum (inde congesti) oriundi, plerumque magni, speciosi.

Ovarium emersum: bacca plerumque anno primo, rarissime anno secundo, maturescens, ovata seu subglobosa, viridis seu raro coccinea, sæpissime floris rudimentis coronata.

Semina plerumque majuscula, fulva, fusca seu nigra, lævia seu scrobiculata, nunquam tuberculata.

This subgenus, characterized mainly by the vertical position of the flowers, principally comprises species from the northern border of the Cactus region, most of them until lately unknown, or imperfectly known, to botanists. All the *Mamillariæ* of the upper Missouri, and most of those from Texas and New Mexico, with which I had become acquainted, have grooved tubercles and showy vertical flowers, which fact I indicated as early as 1845 in the "Plantæ Lindheimerianæ," and again in 1848 in Wislizenus's Report. Dr. Poselger, who in his travels in Texas and Mexico had the best opportunity of studying these plants, further verified this fact, and first noted that all the top-flowering *Mamillariæ* had grooved tubercles, at least in the fully developed parts of the plant; and he justly inferred that all *Mamillariæ* with grooved tubercles (the section *Aulacothecæ*) belong here. But he went further, and removed them from *Mamillaria* to *Echinocactus*, solely on account of the vertical flowers. Now some *Mamillariæ* of this section (e. g. *M. robustispina*) do approach *Echinocactus* in the shape of their embryo, as do others (e. g. *M. macromeris*) by having an occasional sepaloid scale on the ovary; while some *Echinocacti* (e. g. *E. setispinus, E. horizonthalonius*) have a straight embryo with very short connate cotyledons, and others have few and somewhat fugacious sepaloid scales on the ovary (e. g. *E. intertextus, E. setispinus*). Still, I think that a safe line of distinction can be drawn between them, and that *Coryphantha*, though forming a transition to *Echinocactus*, much rather belongs to *Mamillaria*. But it must be admitted that the characters distinguishing most genera of Cactaceæ are almost as difficult to define as those of the species.

11. M. NUTTALLII, β. CÆSPITOSA (*M. similis*, E. in Plant. Lindh. 1845), has been collected by Mr. Wright and others in the same part of Texas where Mr. Lindheimer had originally found it, — namely, from the Brazos to Austin and San Antonio. It has since also been brought from the Kansas River, but does not seem to extend into the mountains of western Texas. (Tab. LXXIV. fig. 7.)

12. M. SCHEERII, Muhlenpf. β? VALIDA: magna, robusta, ovato-globosa, simplex seu ad basin parce prolifera, glaucescens; tuberculis magnis remotis patulis e basi lata subcylindricis, supra sulco profundo glandula singula

paucisve munito (juniore lanato) subbilobis ; axillis latis, junioribus dense tomentoso-lanatis ; areolis orbicu- [11]
latis villosissimis demum nudatis ; aculeis 10–20 rectis seu subinde curvatis robustis rigidis basi bulbosis albidis seu citrinis apice fuscatis, radialibus 9–16 (3–5 inferioribus lateralibusque æquilongis robustioribus compressis, 7–11 superioribus debilioribus teretioribus), centralibus 1–5 validis angulatis paulo longioribus pallidis citrinis seu rubicundis, singulo validissimo porrecto ; floribus in vertice tomentosissimo laxis flavis ; sepalis 16–22 lanceolatis, inferioribus ciliatis ; petalis 16–20 oblongo-lanceolatis versus apicem denticulatis mucronatis ; stigmatibus 6–10 ; bacca viridi.

Sandy ridges in the valley of the Rio Grande, from El Paso to the Cañon ; also at Eagle Spring and on prairies at the head of the Limpia : Charles Wright. Flowers in July. — A stately plant, by far the largest of the northern *Mamillariæ*. Largest specimens before me 7 inches high, 5 inches in diameter without the spines. Tubercles loosely arranged, in the smaller specimens in 8, in the larger ones in 13 spiral rows, at base ¾–1 inch in diameter, suddenly contracted and almost cylindric, 1–1½ inch long and 5–7 lines in diameter, spreading, ascending ; tubercles on the lower part of plant shorter, more conic, and somewhat imbricated. Groove very deep, with 1–5 orbicular depressed or hemispherical warts or glands of nearly a line diameter. Central spines 10–18 lines long, mostly yellow ; lower radial about 9–15, upper 5–10 lines long, — when young mostly red at base, paler in the middle, and dark purplish-black at tip, sometimes yellowish ; when old, all the spines become ashy-gray with dark tip. Flowers 2 inches long, yellow ; ovary 5–6 lines long. Young and small specimens have smaller tubercles, and about 6–8 radial spines 6–9 lines long, with a single straight or recurved much stouter central one an inch long.

M. Scheerii, from Chihuahua, is distinguished from our plant, according to Prince Salm's description, by the shorter and fewer (8–11) radial spines, and the single "much longer, 1 inch long," central spine. It is globose, 3–4 inches in diameter ; flowers of same size as ours, with apparently entire (?) sepals and red-streaked yellow petals. The areolæ are described as naked, while in our plant we find the young ones very thickly covered with long wool, which disappears by age. Nevertheless, I consider ours only as a northern form of the Chihuahua species, with more numerous and stouter spines, which character very often distinguishes northern and southern varieties of one and the same species.

13. M. ROBUSTISPINA, A. Schott in litt. : robusta, simplex seu cæspitosa ; tuberculis magnis patulis subteretibus sulcatis ; areolis magnis orbiculatis, junioribus dense tomentosis ; aculeis radialibus 12–15 robustis rigidis, inferioribus robustioribus obscurioribus rectis seu deorsum curvatis, superioribus rectis fasciculatis paullo tenuioribus ; aculeo centrali singulo valido compresso deorsum recurvato, subinde altero superiore rectiore adjecto, aculeis omnibus corneis apice atratis subpollicaribus ; floribus e basi tuberculorum juniorum villosissima campanulatis luteis ; tubo supra ovarium ovatum constricto tenui, intus ad basin usque filamentoso ; sepalis lanceolatis, inferioribus ciliolatis ; petalis numerosis ; stigmatibus 9–10 patulo-erectis ; bacca viridi ; seminibus magnis oblique obovatis circa hilum parvum lineare centrale curvatis fuscis ; cotyledonibus distinctis foliaceis. (Tab. LXXIV. fig. 8.)

On grassy prairies on the south side of the Babuquíbări mountains, in Sonora ; A. Schott. Flowers July. — A large plant, cespitose, perhaps from the effects of prairie fires, as Mr. Schott suggests. Tubercles nearly an inch long, and about an inch distant from one another ; areolæ 3½–4 lines in diameter. Spines 9–15 lines long, lower ones stouter but a little shorter than the upper ones, dark on the upper and lighter colored on the lower surface ; central spines 1 or sometimes 2, stouter but not much longer than the others ; base of lower or principal central [12]
spine nearly 1 line wide. Flowers 1½–2 inches long, well characterized by the slender tube, which is contracted above the ovary, and quite similar in that respect to the flower of *M. sphærica* (see above) ; petals "saffron-yellow ;" filaments from the base of the tube, leaving no naked space above the ovary, as is the case in most species. Seeds 1.5–1.6 line long, and fully a line in diameter, the largest of any *Mamillaria* examined by me ; albumen more distinct than usual in this genus ; embryo curved, with somewhat foliaceous accumbent cotyledons, resembling much more the embryo of some *Echinocactus* than that of any *Mamillaria* known to me. The plant is evidently nearly allied to the foregoing, and also somewhat to the next species, but is distinguished by the very stout spines, and especially the slender and constricted tube of the flower. In *M. Scheerii* the filaments leave the lowest part of the tube free.

14. M. RECURVISPINA, sp. nov. : simplex, globosa seu depresso-globosa ; tuberculis ovatis obtusis profunde sulcatis confertis subimbricatis ; areolis obliquis ovatis ; aculeis radialibus 12–20 basi bulbosa compressis rigidis recurvis flexuosisve albidis seu corneis apice sæpe adustis intertextis ; aculeo centrali singulo (interdum secundo superiore adjecto) robustiore longiore obscuriore decurvato seu raro rectiusculo ; floribus in axillis villosissimis tuberculorum juniorum subverticalibus majusculis flavicantibus extus fuscatis ; sepalis lanceolatis acutis integris ; petalis erosis.

Eastern parts of Pimeria Alta, in Sonora, especially in the Sierra del Pajarito ; A. Schott. Flowers June to August. — Heads single, mostly depressed, "4–8 inches in diameter" (a living specimen before me has only 3 inches) ; tubercles in my specimen in 13 spiral rows, 5–6 lines long, ovate, somewhat compressed from above ; areolæ very oblique, ovate, 2–2½ lines long, white woolly when young. Radial spines in my living specimen 14–16, in a dried one

as many as 20, according to Mr. Schott's notes 12–14 : one spine is distinctly superior and one inferior ; the others are closely arranged along both sides of the areola, 4–9 lines long, upper ones often a little longer than the lower ones. Central spine 6–10 lines long, dark, mostly strongly recurved, adpressed, so that the plant can easily be handled without hurting ; much like *M. compacta* from the mountains west of Chihuahua, to which it bears a strong resemblance. It seems to be fully distinguished, however, by the arrangement of the flowers, which in ours originate from the base of full-grown tubercles, and are scattered over the top of the plant, being pushed out by younger tubercles bearing new buds ; while in the Chihuahua species they come from the axils of young, just growing tubercles, and are crowded on the densely woolly top. Flowers about 1½ inch long and of the same width ; petals lemon-yellow, darker, and with a brownish tinge outside along the midrib.

15. M. PECTINATA, sp. nov. : simplex, globosa ; tuberculis e basi quadrangulata conicis, inferioribus abbreviatis, summis floriferis teretibus longioribus sulcatis ; areolis orbiculato-oblongis ; aculeis 16–24 omnibus radiantibus plerumque subæqualibus seu summis fasciculatis longioribus, e basi bulbosa lateraliter compressa subrecurvis, pectinatis luteo-albidis demum cinereis apice sæpe sphacelatis intertextis ; floribus e vertice tomentosissimo centralibus flavis ; ovario globoso ; tubo brevi amplo ; sepalis sub-30 acutis aristatis, exterioribus lanceolatis apice recurvis, interioribus oblanceolatis adpressis ; petalis sub-30 pluriserialibus oblanceolatis seu intimis obtusis retusisve, omnibus herbaceo-aristatis ; stigmatibus 9–10 linearibus luteo-albis stamina longe superantibus ; bacca ovata viridi floris rudimentis coronata ; seminibus elongato-obovatis compressis lævibus lucidis fuscis, hilo parvo ventrali. (Tab. XI.)

On gentle slopes of the limestone hills on the Pecos, and at Leon Spring ; abundant at the latter place : [13] Charles Wright. Flowers in June and July. — The globose heads are 1½–2½ inches in diameter. Tubercles in 13 spiral rows ; lower ones 2–3 lines long, and somewhat broader at base, not grooved, or with a very short groove near the spines ; upper tubercles 5–6 lines long, and grooved all the way down. Spines on lower part of plant nearly equal in length on each tubercle, 3–4½ lines long, as stiff and pointed and almost as closely and regularly set as in *Cereus pectinatus*, whence the specific name. On the flower-bearing tubercles the upper spines are elongated, mixed with a few stouter ones, and fasciculated ; lower ones 5–6 lines long, and upper ones, forming a tuft about the apex of the stem, 6–9 lines long. Flower over 2 inches long, and 2¾ inches in diameter when fully open, between 11 and 12 o'clock, closing already about 1 o'clock though exposed to the full glare of the sun ; ovary 3–4 lines long ; exterior sepals reddish-green, interior ones yellow, with a darker midrib ; petals of a beautiful sulphur-yellow, broadest in the upper third and obtusish ; filaments reddish, short, covering the whole base of the tube, leaving no naked space. Fruit about half an inch long, ripening on the vertex, and not pushed aside by succeeding young tubercles, as it seems that no new ones are developed till the fruit is fully ripe, or probably till the succeeding spring. This is the case with several allied yellow-flowering species, but not with other red-flowering ones, hereafter to be described : in these, though the flower (or at least the flower-bud) be vertical, the succeeding rapid growth pushes them aside ; and still more the berries, which finally appear quite lateral. Seed 0.9 line long, elongated, compressed, rounded at the back, quite sharp at the anterior or ventral edge, on the lower part of which, in a slight curvature, the small and narrow hilum is situated.

16. M. ECHINUS, sp. nov.: simplex, globosa seu subconica ; vertice dense tomentoso ; tuberculis in planta adulta teretibus apice conicis supra sulcatis ; areolis orbiculatis ; aculeis rectis seu paullo curvatis cinereo-albidis apice sæpe obscurioribus, radialibus 16–30 pectinatis, superioribus longioribus fasciculatis, centralibus 3–4 validioribus e basi bulbosa subulatis, superioribus 2–3 sursum versis et cum radialibus superioribus implicatis, inferiore validissimo subulato recto (seu rarissime paullo recurvo) porrecto ; floribus verticalibus flavis ; sepalis 20 lineari-lanceolatis mucronatis integris, petalis 20–30 angustis ; stigmatibus sub-12 stamina longe superantibus ; bacca centrali oblonga viridi floris rudimentis coronata ; seminibus ut in præcedente. (Tab. X.)

On limestone hills in the region of the Pecos, Wright ; and from Presidio del Norte to Santa Rosa, Bigelow. Flowers in June. — A very striking plant, characterized by the unusually stout and subulate lower central spine, which, together with the globular shape, gives it the appearance of some Echinite, — whence the name. Specimens before me 1½–2 inches in diameter ; tubercles 5–6 lines long, in 13 spiral rows. The numerous slender but very stiff whitish radial spines, laterally compressed at the thickened base, are densely interwoven and closely adpressed ; lower ones about 5 lines long, lateral ones somewhat shorter, upper ones 6–8 lines long ; upper interior spines stouter and rather longer than the upper radial ones, but otherwise hardly distinguishable from them ; the lower central spine is also about 6 or 8 lines long, very regularly subulate from a thick base. Flowers between 1 and 2 inches long ; to judge from the shrivelled specimens seen, yellow. Fruit over half an inch in length. Seeds about 0.9 line long, entirely similar to those of the last species, to which this, perhaps, too closely approaches. All the specimens from the Pecos have very straight central spines ; but some from Presidio del Norte, not otherwise different, [14] have somewhat recurved and darker horn-colored central spines.

17. M. SCOLYMOIDES, Scheidw. A small slender-spined form was collected by Mr. Wright on the Pecos, and

by Dr. Bigelow about Santa Rosa. Tubercles compressed, incurved, imbricated. Radial spines on the upper ones about 20, with 4 longer and darker incurved central ones; the upper ones bent upward, and almost mixed with the upper radial ones; lower one mostly over an inch long. This species and the two preceding may possibly be forms of De Candolle's *M. cornifera*.

18. M. CALCARATA, E. in Plant. Lindh., has been collected by Mr. Wright as far west as the Nueces River. His specimens have only 8 or 10 radial spines, 4–6 lines long; central spine of the same length, but stouter, often (in young specimens?) entirely wanting. Lindheimer's original specimens from the neighborhood of the Colorado and Guadaloupe Rivers have 10–12 radial spines, 8–9 lines long; central spine stouter but shorter, sometimes wanting; seeds similar to that of *M. pectinata*, but larger and very obtuse at base; 1.1 to 2 lines long. (Tab. LXXIV. fig. 1.)

19. M. TUBERCULOSA, sp. nov.: ovata seu ovato-cylindrica, simplex seu ad basin ramosa; tuberculis e basi rhomboidea ovatis abbreviatis obtusis, subcompressis, profunde usque ad axillam villosissimam sulco villoso exaratis confertis imbricatis, demum nudatis suberosis persistentibus; areolis orbiculatis, novellis albo-tomentosis; aculeis exterioribus 20–30 rigidis gracilibus albidis nunc apice sphacelatis radiantibus intertextis, interioribus 5–9 robustioribus sursum cæsio-purpureis apice sphacelatis, quorum superiores longiores erecti versus caulis apicem in comam aggregati, inferior brevior robustus porrectus deflexusve; floribus in vertice densissime tomentoso centralibus pollicaribus dilute roseis; sepalis 16–18 lanceolatis arachnoideo-fimbriatis; petalis 10–13 lineari-lanceolatis aristatis subintegris; bacca ovata elongata floris rudimentis breviter convolutis coronata rubra; seminibus subgloboso-obovatis scrobiculatis fuscis, hilo ovato minuto ventrali. (Tab. XII. fig. 1–16.)

From the Pecos to Leon Springs, Eagle Springs, and El Paso, on the higher mountains, Wright; especially on the rocky summits of the "Flounce Mountains," below El Paso, Bigelow. Flowers in May and June. — A very pretty and well-defined species of the mountain region. Stems 2–5 inches high, 1–2 inches in diameter, often with globose branches at the base; tubercles mostly only 3 lines long, and of the same width at base, often shorter, rarely and only in very vigorous plants 4 or even 5 lines long; in 13, or on the lower part of old plants in 21, spiral rows, like the whole body of the plant, of a corky texture and substance, almost dry, and therefore not shrivelling when old, but, after shedding the spines, persistent and covering the older parts of the stem as grey, corky tuberosities, whence the name. The deep, densely woolly groove, and the very woolly axilla, which loses its coating only after several years, are quite peculiar to this species. Radial spines usually 22–26, rarely less than 20, and never in the numerous specimens examined by me more than 30, very slender but stiff, usually 2–4 lines long, lower and a few upper ones 2 lines, most upper ones 3–4 lines long, uppermost rarely 5 or even 6 lines in length; lower stout central spine 3–4, upper ones 5–7, and in a few specimens even 8 or 9 lines long; those of the uppermost tubercles crowded together, erect, forming a purplish gray tuft, which surrounds and partly hides flowers and fruit. Flowers very pale purple, about 1 inch in diameter; berry oval, elongated, and sometimes almost cylindric, red, and by both these characters distinguished from the fruit of the allied species; remains of flower not irregularly shrivelled up as in those [15] species, but forming a regular, conic, whitish head on the red fruit. Seeds 0.4 or 0.6 line long, unusually thick, with a very small oval, not linear, hilum.

20. M. DASYACANTHA, sp. nov.: simplex, subglobosa; tuberculis teretibus leviter usque ad basin sulcatis laxis; axillis sulcoque subvillosis mox nudatis; areolis orbiculatis novellis, albo-tomentosis; aculeis gracilibus vix spinescentibus rectis patulis, exterioribus 25–35 capillaceis albidis apice sphacelatis, interioribus 7–13 setaceis longioribus infra pallidioribus sursum purpureo-fuscis apice atratis, centrali singulo æquilongo porrecto nunc deficiente; florum parvorum centralium sepalis arachnoideo-fimbriatis; baccis verticalibus ovatis parvis; seminibus obovato-globosis angulatis scrobiculatis nigricantibus; hilo lineari subventrali. (Tab. XII. fig. 17–22.)

El Paso and Eagle Springs; Wright. — The few specimens before me are from $1\frac{1}{2}$–$2\frac{1}{2}$ inches high, a little less in diameter; tubercles slender, 4–5 lines long, in 13 spiral rows; grooves slightly hairy when young; axils more or less villous, soon becoming naked. Spines not strictly radiating, but loosely spreading, much more slender than in the last and the next species, often even capillary; exterior ones 3–6 or even 9 lines long; interior spines forming a circle corresponding with the exterior ones, but darker, stiffer, and longer; upper ones 8–12 lines, lower ones 6–9 lines long, or in some specimens shorter and slenderer; central spine single, erect, 6–10 lines long, often wanting. The dry and shrivelled fruit found on the tomentose vertex was only $3\frac{1}{2}$ lines long; seeds thick, sometimes triangular, with a very broad back, 0.4–0.6 line long, almost black; hilum quite different in shape and position from that of the next species, to which this is closely allied. The plant so much resembles *Echinocactus intertextus*, var. *dasyacanthus*, that at first sight it might be taken for it.

21. M. VIVIPARA, Haw. *Cactus viviparus*, Nutt. Gen. This species is found only on the northwestern plains, along the upper Missouri and Yellowstone rivers, and up into the Black Hills and Rocky Mountains. It is a low plant, either simple or usually profusely proliferous and cespitose; shoots always from the base of the groove on the

tubercle or the axil proper, while in *M. calcarata* they come from the upper part of the groove, just below the spines. Radial spines 12–20, stiff, white, often brown-red at the top, 3–4 lines long; central spines 4 (3 pointing upward and the stoutest and shortest downward), but sometimes less, and often more, as many even as 8, usually 4–6 lines long. Flowers central, large for the size of the plant, about 1½ inch long, and even more in diameter when fully open (which is after one o'clock, later than in most other Cactaceæ), with 30 or more delicately fimbriate recurved sepals and 25–40 narrow acuminate purple petals, which are naked or fimbriate at base; filaments whitish or purplish, almost from the base of the tube; anthers orange; style long-exserted, with 5–10 linear pale or purple stigmata, which are pointed with a short mucro. Berries becoming lateral, being pushed aside by the continuous growth from the apex of the plant, oval, ½–¾ inch long, pale green, juicy, and slightly acid, full of yellowish-brown seeds. These are 0.7–0.8 line long, obliquely obovate, somewhat concave on the compressed ventral portion about the small oblong-linear hilum, pitted; albumen more distinct than in most other *Mamillariæ;* embryo straight, linear-oblong, with very short connate cotyledons. (Tab. LXXIV. fig. 3.)

The following form, from Texas, which formerly I thought I could distinguish from this northern species, seems to be connected to it by numerous intermediate forms found in the geographically intermediate region of New Mexico: —

Subsp. β. RADIOSA: ovata seu demum subcylindrica, simplex seu e basi ramosa; tuberculis teretibus laxis leviter sulcatis; aculeis radialibus numero maxime variis (12–40), superioribus longioribus robustioribus, cen- [16]
tralibus, 3–12, quorum superiores robustiores, radialibus longiores, inferior robustus porrectus brevior; floribus in vertice demum lateralibus; sepalis 30–40 lineari-lanceolatis arachnoideo-fimbriatis apice recurvis squarrosis; petalis totidem linearibus sensim acuminatis integris seu exterioribus basi fimbriatis; stigmatibus 5–10 obtusis purpureis patulis; bacca ovata floris rudimentis coronata viridi; seminibus obovatis scrobiculatis fulvis, hilo erecto parvo lineari ventrali.

Var. α. BOREALIS: ovata seu subglobosa, subsimplex; aculeis radialibus 12–20, centralibus 3–6 purpureo-maculatis; floribus minoribus; sepalis sub-25; petalis sub-30; seminibus minoribus ventre concavis. *M. vivipara*, var. E. in Plant. Fendl. in Mem. Amer. Acad. (Tab. LXXIV. fig. 4.)

Var. β. NEO-MEXICANA: ovata seu ovato-cylindrica, sæpe e basi ramosa; aculeis radialibus albidis sub-30 (20–40), centralibus 6–9 (3–12) infra albidis sursum purpurascentibus apice atratis; floribus majoribus; seminibus majoribus ventre subconcavis.

Var. γ. TEXANA (*M. radiosa*, E. in Plant. Lindh.): ovato-cylindrica, subsimplex; aculeis radialibus 20–30 albidis apice adustis, centralibus 4–5 flavis seu fulvis; floribus majoribus; sepalis 40–50; petalis 30–40; stigmatibus 7–9; seminibus magnis ventre subconvexis. (Tab. LXXIV. fig. 5.)

Var. α has been collected in northern New Mexico and about Santa Fé by Wislizenus and Fendler: β in the western parts of Texas and the southern parts of New Mexico by Wright and Bigelow; by the latter also on the upper Pecos, and in Sonora (a form with more spines than any other) by Schott. Var. γ was sent by Lindheimer from the Pierdenales, a tributary of the Guadaloupe in western Texas. Flowers in May and June. — Var. γ is the largest form, 2–5 inches high, with flowers 1½–2¼ inches in diameter when fully expanded, and seeds fully 1 line long. — Var. β is an intermediate form, 1½ or 2 to 4 inches high, 1–2½ inches in diameter; tubercles 3–6 lines long. Spines very variable in length and number; in smaller younger specimens the exterior spines are 2–4 lines and the interior 3–6 lines long; in larger ones the former are often 3–8 lines and the latter 5–10 lines long. Seed 0.7–0.9 line long, almost straight on the side of the hilum, or usually somewhat concave. — Var. α approaches very near to *M. vivipara* of the north. The spines, however, are stouter, the flowers smaller, and the tubercles rarely proliferous; seeds as large as in the last, and of similar shape.

22. M. MACROMERIS, E. in Wisliz. Rep.: simplex, seu ex sulcis tuberculorum inferiorum prolifera et demum cæspitosa, ovata seu cylindracea, læte viridis; tuberculis magnis e basi dilatata elongatis teretiusculis supra sulco (juniore villoso) ad medium ultrave usque ad areolam floriferam tomentosam supra-axillarem producto exaratis adscendentibus patulis laxis seu rarius plus minus imbricatis; aculeis gracilibus elongatis teretibus seu robustioribus sæpe angulatis compressisve rectis seu paulo curvatis, exterioribus sub-12 (10–17) patulis albidis seu junioribus subinde rubellis apice sphacelatis, inferioribus sæpe paulo brevioribus; aculeis centralibus 4 (in plantis junioribus sæpe 1–3 raro deficientibus), longioribus robustioribus basi bulbosis plerumque nigricantibus, raro roseis fuscisve; floribus supra-axillaribus magnis e coccineo purpureis; ovario nudo seu squama una alterave sepaloidea munito; sepalis tubi 20–30 lanceolatis, inferioribus fimbriatis, superioribus integriusculis; petalis 20–25 oblongo-lanceolatis versus apicem denticulatis mucronatis; stigmatibus 7–8 supra stamina longe exsertis; bacca ovato-subglobosa nuda seu squamis paucis ciliatis instructa viridi; seminibus globoso-obovatis lævibus fulvis, hilo oblongo-lineari [17]
ventricali; albumine parco; embryone recto; cotyledonibus minutis. (Tab. XIV.–XV.)

In the valley of the Rio Grande, from Doña Ana, above El Paso (Wislizenus), to the cañon below that town (Wright), and to the mouth of the Pecos and to Eagle Pass (Bigelow); and lower down, mostly in loose sand, on hillocks

confined by the roots of *Algarobia*. Flowers July and August. — A splendid and very interesting species, 2–4 inches high. Tubercles very different in size in different specimens, from 6 or 7 to 10 or 12 and sometimes even 15 lines long, generally arranged in 8 spirals. The groove is absent in the tubercles of the young plant; in the older ones it shows itself slightly, and only near the point of the tubercle from the spines downward. In more fully developed tubercles it becomes longer; till in the flower-bearing ones it reaches downward to the lower third, but never to the axilla. There it enlarges into the flower-bearing areola. — Radial spines 6–20 lines long, whitish on the upper ones or all rose-colored when young; central spines 1–2¼ inches long, the lowest one longer and stouter than the rest, mostly black, in some specimens paler, straight, or sometimes curved or twisted. Flower 2½–3 inches long and of the same diameter; deep rose-color or carmine verging to purple; darker along the centre and toward the tip. Fruit 8 to 10 or 12 lines long. Seeds different in size, 0.7–0.8 line long, short and thick, with a decidedly ventral hilum. Albumen distinct, more so than in most other *Mamillariæ*, but the embryo quite similar to them. The scales on the ovarium indicate an approach to *Echinocactus*, though the habit of the plant is decidedly that of a *Mamillaria*.

M. dactylothele, Lab., is a variety of this species.

Subgen. 3. Anhalonium.

Plantæ simplices, tuberculatæ, subinermes.
Tubercula subfoliacea, triangularia, lævia seu supra verrucoso-fissurata.
Areolæ floriferæ supra-axillares (an semper?), jubato-villosissimæ.
Flores ex areolis tuberculorum hornotinorum nascentium oriundi, in vertice congesti, mediocres.
Ovarium emersum: bacca floris rudimentis coronata, plerumque anno primo maturescens.
Semina majuscula, nigra, tuberculata.

These very curious plants, some of them looking more like some *Aloë* than like a *Cactus*, can nevertheless not be separated from *Mamillaria*. The seed is the only part of the organs of fructification which seems to offer any character, by having a hard, roughly tuberculated testa in ours, as well as in another Mexican species which I had the opportunity to examine. Our species (and probably all the others) has the flower and fruit sessile upon the lower part of the tubercle, and elevated above the axil, much as in *M. macromeris;* but, unlike that plant, the lower part of the tubercle is entirely distinct from the upper one.

23. M. fissurata, sp. nov.: e radice crassa napiformi simplex, depresso-globosa seu applanata; vertice densissime villoso; tuberculis e basi applanata dilatata crassis triangularibus inermibus extus infraque lævibus seu versus marginem crenulatum rugosis, supra sulco centrali villoso lateralibusque 2 nudis profunde quadripartitis et sulcis transversalibus in tubercula irregularia angulosa numerosa multifidis; floribus e villo longo sericeo centralibus breviter tubulosis; sepalis sub-20, inferioribus lineari-lanceolatis integris carnosis albidis, superioribus spathulatis cuspidatis; petalis sub-12 spathulatis versus apicem obtusum mucronatum integriusculis seu laceris roseis; stigmatibus 5–10 erecto-patulis; baccis ovatis pallide virescentibus in lana densa occultis; seminibus obovato-globosis tuber- [18] culatis nigris opacis, hilo basilari transverso; embryone obovato erecto. (Tab. XVI.)

On hard, gravelly, limestone hills, near Fairy Springs, not far from the mouth of the Pecos, and between that river and the San Pedro, Schott, Bigelow; and higher up on the rocks of the cañon of the Rio Grande, Parry. Flowers September and October. — The lower part of the plant is top-shaped, covered with the scale-like remains of earlier tubercles; the upper part is hemispherical or depressed and flattened, hardly elevated above the surface of the ground, 2–4½ inches in diameter. Tubercles in my specimens 6–10 lines long and a little less broad, or sometimes the upper warty part "¾ inch long and 1¼ inch wide," in 5 or 8, or rarely in 13 spiral rows; lower part of tubercles flattened, acute at the edges, slightly carinate, more on the upper and less on the lower surface, smooth; upper and exposed part of tubercle triangular in outline, convex, carinate and almost smooth below, convex and variously fissured and thereby verrucose above, sharp and crenate on the edges. The principal groove on the upper surface is a longitudinal one corresponding to the groove of the different species of *Coryphantha*, and like that villose; towards its base (at the base of the upper or warty part of the tubercle) it expands into the floriferous areola; upward it ceases just under the acutish point of the tubercle, without any trace of an aculeiferous areola or of spines. In the young tubercle it is coated by dense, long and straight, white or yellowish, silky wool (about an inch long), which from being exposed to the weather gets matted and dirty, and after several years entirely disappears. Two lateral grooves run parallel with this, and, together with the many transverse fissures, cut up the upper surface into numerous angular tubercles or warts. Flowers central or vertical (in the sense of the term as explained before), borne on the lower smooth part of a very young tubercle, which when bearing flower and fruit is somewhat thickened, and takes the shape and functions of a short peduncle, bearing laterally the upper part of the tubercle like a small bract; the axils even of these young tubercles are entirely naked, the long wool which covers the lower part of the flower and entirely hides the whole fruit being produced entirely from the areola and the central groove. Flower about an inch long, and of the same diameter when fully open; ovary 3 lines long, oval; tube 4–6 lines long; 12 exterior sepals whitish, fleshy, 8 inner

ones spatulate, mucronate, with rose-colored edges 6–9 lines long, 2 lines wide; petals about 12 in a single series, 9 lines long, 2 lines wide, rose or pink-colored; stamens numerous, white, with orange anthers; style white, expanding into a funnel-shaped irregularly 5–10-parted light-yellow stigma. Fruit oval, crowned with the remains of the flower, about 5 lines long, juicy. Seed 0.8 line long, strongly tuberculated, the transverse and somewhat truncate hilum basilar.

II. ECHINOCACTUS. Link & Otto.

1. **E. Scheerii, Salm: e radice tereti elongata parvus, globosus seu ovatus; costis 13 obtusis interruptis; tuberculis ovatis obtusis supra ad medium sulcatis; areolis ovato-orbiculatis junioribus albo-tomentosis; aculeis radialibus 15–18 setaceis rigidis rectis seu plerumque paulo recurvatis albidis stramineisve apice fuscatis, summo interdum elongato, centralibus 3–4 angulatis variegatis fusco-atris, superioribus rectis sursum divaricatis longioribus, inferiore porrecto hamato breviore; floribus in vertice laxis; sepalis exterioribus 13 squamiformibus, inferioribus appendiculato-auriculatis margine membranaceo laceris ciliatis, superioribus ovatis integriusculis, sepalis interioribus 8 lineari-oblongis obtusis; petalis 13 lineari-lanceolatis acutis flavo-virescentibus; stigmatibus 8 linearibus flavis; bacca virescente indistincte squamata; seminibus oblique obovatis compressis minutissime tuberculatis [19] fuscis, hilo ventrali circulari magno. (Tab. XVII.)**

About Eagle Pass, on the Rio Grande; Schott, Bigelow. Flowers in April. — A most elegant little species, $1\frac{1}{2}$–2 inches in diameter, and of the same height. Root long, terete, rather fleshy, white, about $\frac{1}{4}$ inch in diameter, such as I have not seen in any other of our *Cactaceæ*. Tubercles more distinct and less plainly arranged in ribs than in the other species of this genus; they are 4 or 5 lines high, somewhat compressed, of the same transverse diameter, and a little longer in the other direction. Areola about $1\frac{1}{2}$ line long, a little less broad, extending upward into a tomentose groove, 1–$2\frac{1}{2}$ lines long, which terminates in the floriferous areola half-way down to the axil, as the transverse incision in the rib may be designated; this groove is much shorter or almost wanting on the tubercles, which bear no flowers. The exterior spines, with their bulbous compressed bases, are closely and regularly arranged all around the areola, and are strictly radiating: in younger plants I find 11–13, in older flower-bearing tubercles always 15–18 radial spines, 3–5 lines long, of almost equal length, or the lateral ones a little longer than the rest; the uppermost radial spine, however, is often somewhat stouter and longer, ranging rather as an upper central spine when only 3 of these are present. The upper central spines (2 in my specimens from Eagle Pass, 3 in Salm's original plant) are stouter, somewhat compressed and angled, brown or black on the upper and whitish or mottled on the lower surface, or they are lighter throughout, with black tips, — they are 8–12 lines long; the lower central spine is 2 or 3 lines shorter, black on the upper side, especially at base, and at the hooked point white on the lower surface and again on the outside of the curvature. The green flowers are about an inch long, much less in diameter even when fully open. Fruit and seed not seen by our collectors. The former is said by Dr. Poselger (who has sent me a good specimen of the plant, entirely agreeing with my specimens) to be a small green and almost naked berry. His seeds are large, about 1 line long, 0.8 line in diameter, with very minute and flattened tubercles, *brown* (the only *Echinocactus* with seeds of that color known to me); hilum large and circular, surrounded by a thick rim; albumen very small; embryo curved, but cotyledons small, connate, more like those of a *Mamillaria*, separating on the curvature, and not at the end of the hook, as in all other hooked embryos of *Cactaceæ* known to me.

2. **E. brevihamatus, sp. nov.: e radice turbinata fibrosa globoso-obovatus, atro-viridis; costis 13 compressis tuberculato-interruptis; sulcis acutis profunde incisis; tuberculis supra ad basin usque tomentoso-sulcatis; areolis orbiculatis junioribus breviter albo-tomentosis; aculeis radialibus 12 teretibus rectis albidis seu sordide flavis apice adustis, superioribus longioribus; centralibus 4 complanatis albidis apice atratis, lateralibus sursum divergentibus rectis seu paulo recurvatis aculeos radiales superantibus, summo debiliore et infimo porrecto seu deflexo deorsum hamato robustiore eos subæquantibus; floribus infundibuliformibus roseis; sepalis inferioribus (ovarii) 5–7 reniformibus scariosis ciliatis, superioribus (tubi) 8 ovato-oblongis mucronatis obtusisve; petalis 13–14 lineari-lanceolatis acutis mucronatis integris; stigmatibus 10–11 radiatis flavis stamina rubella paulo excedentibus. (Tab. XVIII., XIX.)**

On the San Pedro, Wright; and not rare about Eagle Pass, Bigelow. Flowers March and April. — The specimens sent by the gentlemen of the Boundary Commission were from 2 to 4 inches high and 2–3 in diameter, of a very dark green color, and remarkable from the tuft formed on the apex by the upper central spines, in which the numerous flowers are almost entirely hidden; the lower hooked central spines stand out from the mass of the other spines, the hooks turned downward. All the specimens grew well at first, one flowered abundantly, but all soon died [20] from an internal rot; just as all the specimens of *E. uncinatus* did, though they were treated like the other *Cactaceæ* from the same region, which are doing well. Areolæ 2 lines in diameter, 8–12 lines distant, connected with the floriferous areolæ in the axils of the tubercles by a tomentose groove of 4 or 5 lines in length. Radial spines almost always 12, very rarely 1 or 2 more, 5–10 lines long; upper ones longer than the lower and light-colored, lateral

ones darker when young, but difference of shade soon lost. Upper central spine 8–10 lines long; lateral ones usually 14–22 lines in length, always exceeding the upper and lower one, — this last one is the stoutest and broadest of all, 9–14 lines long, mostly yellowish-brown, darker on the upper, lighter on the lower surface, and with the hook brown or black; rarely 1 or 2 additional central spines are noticed. Flower 12–16 lines long, only 9 or 10 lines wide when fully open at noon; petals 7–8 lines long, 2 lines wide, pale rose-colored, with a deeper colored midrib. Fruit and seed unknown. — Near the last species; distinguished by the larger size, the very different root, the smaller number of radial spines, the shortness of the upper central spine, and the red color of the flowers. Other differences will no doubt be found in fruit and seed. Name from the shortness of the hook, by which the species is distinguished from most other allied forms.

3. E. UNCINATUS, Hœpf., var.? WRIGHTII: glaucescens, ovatus; costis 13 compressis tuberculatis supra usque ad basin sulcatis; areolis ovato-orbiculatis, junioribus albo-lanatis; aculeis radialibus 8, inferioribus 3 brevioribus teretibus uncinatis purpureo-fuscis, cæteris 5 compressis rectis infra stramineis sursum rubellis apice fuscis, summis longioribus latioribusque, centrali singulo complanato basi angulato flexuoso elongato hamato erecto stramineo apice fusco; floribus ex areola penitus axillari ortis; sepalis inferioribus 25–30 imbricatis squamæformibus e basi longe auriculata triangularibus hyalinis, mediis 15–25 ovato-orbiculatis cordatis acutis purpurascentibus, superioribus 18–20 lineari-oblongis obtusis purpureo-fuscis, sepalis omnibus margine membranaceo albido ciliatis; petalis 20–30 linearilanceolatis obtusiusculis purpureis, internis mucronatis denticulatis; stylo supra stamina numerosissima exserto stigmatibus 10 carneis suberectis; bacca ovata rubella; seminibus curvatis oblique obovatis tuberculatis; hilo circulari basilari. (Tab. LXXIV. fig. 10.)

Near El Paso, and on the river below; also at Eagle Springs, on stony hills and nearly to the top of the mountains, commonly in tufts of grass or hidden among low bushes: Wright, Bigelow. Flowers in March and April. — Oval, 3–6 inches high, 2–3½ inches in diameter, with a long tuft of the whitish hooked central spines, which are at first difficult to distinguish from the surrounding bunches of dead grass. The adult plants have generally 3, very rarely 4, lower hooked radial spines, ¾–1¼ inch long; 5 lateral and upper radial spines, 1–1½ inch long, paler and flattened, the uppermost one longer, broader, and whiter than the rest. Sometimes I find 6 upper spines, when the 3 outer and more slender ones appear radial, and the 3 inner and stouter ones assume the position of 3 upper central spines, — there are then 6 radial and 4 central spines; the hooked central spine is 2–4 inches long, and not annulated. Young plants have 6–7 radial and 1 central spine, all terete and purplish, with darker tips, all ½–1 inch long; in older specimens the central spine elongates, and finally becomes flattened and whitish. Groove on the tubercles 2–3 lines long, so that the *axillary* flower is distant thus far from the spines. Flower 1–1½ inch long, dark purplish-red, opening at midday in bright sunshine; filaments at least 1000, yellow below, orange at tip. Fruit ovate, 8–12 lines long, pulpy-red, setting off the white membranaceous sepaloid scales. Seed 0.7–0.8 line long, remarkably curved and [21] contracted at the base, compressed (more so in the ventral curvature), carinate on the back, tuberculate; the small circular hilum surrounded by a very tumid, smooth, and shining rim; albumen large; embryo hooked, with foliaceous cotyledons.

The Mexican *E. uncinatus* — of which I have seen spines and seeds collected by Dr. Poselger between Saltillo and San Luis Potosi, and flowers found by Dr. Gregg near Parras — has 7–8 radial spines (the 3 lower ones of which are hooked) and 4 central ones, the lowest one flattened and elongated; lower sepals 36, upper ones about 14, oblanceolate, aristate, margined; petals 25, linear-lanceolate, acuminate, aristate; 8–10 stigmata. Seeds 0.6–0.7 line long, very much compressed, curved, almost cochleate, smoothish and shining; circular hilum almost ventral; albumen and embryo same as in the other. (Tab. LXXIV. fig. 9.)

4. E. SETISPINUS, E. in Plant. Lindh. Many forms have been collected by the Commission, all characterized by 13 narrowly compressed ribs, slender flexible spines, small bright-red globose fruit, and globose-obovate oblique strongly tuberculated seeds, with an almost circular basilar hilum. The heads are globose, or usually lengthened and almost cylindrical when old, but sometimes depressed. Spines short or long, the central spine usually somewhat longer than the others, but in some specimens from the Rio Grande shorter; in others from Eagle Pass much longer than the others, and erect, sometimes hardly curved. Seed usually 0.6 line long; in the above-mentioned specimen from Eagle Pass 0.8 line in length.

The geographical range of this species is from the Brazos south to the Rio Grande — whence Berlandier has sent it under the name of *Cactus bicolor* — and west to near the San Pedro. (Tab. XX.)

5. E. SINUATUS, Dietr. (*E. setispinus*, γ *sinuatus*, Poselg.): globosus, læte viridis; costis 13 obliquis compressis acutatis interruptis; tuberculis breviter sulcatis; areolis orbiculatis, junioribus albo- seu griseo-villosis; aculeis radialibus 8–12 setiformibus flexilibus, 3 inferioribus et 3 superioribus purpureo-fuscis rectiusculis, lateralibus 2–6 tenuioribus longioribus sæpe compressis rufis seu interdum flexuosis hamatisve albidis; aculeis centralibus 4 quorum 3 superiores graciles compressi seu sub-angulati erecti plerumque recti, infimus latior compressus seu canaliculatus flexuosus elongatus stramineus basi purpurascens apice subhamatus; floribus ab areola aculeifera paulo

distantibus ; sepalis inferioribus 20–30 cordato-auriculatis, superioribus 15–20 lanceolatis basi auriculatis margine membranaceis ; petalis 20–25 lanceolatis sulphureis ; stylo longe supra stamina exserto ; stigmatibus 8–12 apiculatis erecto-patulis ; bacca ovata squamis 7–10 munita viridi ; seminibus obovatis seu lenticularibus hilo oblongo subbasilari excisis lucidis sub lente minutissime punctatis. (Tab. LXXIV. fig. 11–14.)

On the Pecos, San Pedro, and Rio Grande rivers ; Wright, Schott. — I have above given a careful description of this plant, because it is so nearly allied to the foregoing and especially to the next species, which Dr. Poselger thinks it connects. With the former it has in common only the compressed ribs and the setaceous radial spines, but is distinguished by its size, the central spines, the fruit, and especially the seed. From the next species, which it much more closely resembles, it is distinguished by the compressed ribs, the slender radial spines, the smaller number of all parts of the flower, the small fruit, and the smaller very finely punctate seed. My specimens are 4 or 5 inches in diameter, while Dr. Poselger's were 8 inches thick. Areolæ 8–10 lines apart ; 3 lower spines smooth, purplish-brown, lighter at top, $\frac{3}{4}$–1 inch long; lateral spines puberulent, straw-colored, 1–$1\frac{1}{2}$ inch long ; central spines puberulent, 3 upper ones yellowish, generally darker at base, $1\frac{1}{2}$–2 inches long ; lower central spine much stouter and longer than all the others, and flattened or even channelled, pale-yellowish, often purplish at base, flexuous, [22] more or less hooked, sometimes straight, 2–4 inches long. Flowers 2–3 inches long, yellow, apparently without the scarlet base of the petals, which I always find in both the allied species externally greenish. Fruit oval, 8–9 lines long, with 7–12 scales ; green when ripe. Seeds 0.4–0.6 line long. Dr. Poselger describes another form under the name of *E. setispinus δ. robustus*, which is said to have all 4 central, and often the 3 lower radial spines also, more or less hooked. The seed which he has sent to me leaves no doubt in my mind that it is a form of *E. sinuatus*. In my specimens only the lateral spines sometimes are flexuous, or hooked, or almost curled.

6. E. LONGEHAMATUS, Galeotti : subglobosus seu demum ovatus, læte-viridis ; costis 13–17 sæpe obliquis tuberculato-interruptis latioribus obtusis ; tuberculis ovatis supra brevissime sulcatis ; areolis ovatis seu suborbiculatis distantibus ; aculeis junioribus plerisque purpureis, adultis demum totis cinereis ; radialibus 8–12 rectis curvatis flexuosisve patulis, superioribus gracilioribus pallidioribus, infimo brevi, lateralibus longioribus subannulatis ; aculeis centralibus 4 (1–4 superioribus adventitiis subinde adjectis) angulatis compressis annulatis, quorum superiores recti seu curvati seu contorti sursum versi, infimus robustior plerumque longissimus sæpe flexuosus plus minus uncinatus porrectus vel deflexus ; floribus ab areola aculeifera vix sejunctis infundibuliformibus, limbo patulo ; ovario ovato ; sepalis scarioso-marginatis ciliatis, inferioribus 30–60 squamiformibus reniformibus, mediis 10–20 obovato-spathulatis, superioribus 15–20 demum oblongo-obovatis obtusis cuspidatis ; petalis 20–30 oblanceolatis obtusis vel retusis denticulatis cuspidatis seu mucronatis sulphureis ima basi coccineis et sæpius dorso rubellis ; stigmatibus 15–18 obtusis sulphureis patulis ; bacca ovata squamosa viridi ; seminibus globoso-obovatis hilo ovato subbasilari oblique excisis scrobiculatis lucidis. (Tab. XXI.–XXIV.)

Var. *α.* CRASSISPINUS. *E. flexispinus*, E. in Wisliz. Rep. non Salm. : aculeis robustissimis, radialibus 8–11, centralibus, 4 angulatis, infimo flexuoso plus minus hamato.

Var. *β.* GRACILISPINUS : aculeis gracilioribus 16–20, exterioribus 12–14, centralibus 4–8, infimo elongato hamato. *E. hamatocanthus*, Muehlenpf.

Var. *γ.* BREVISPINUS : aculeis gracilioribus, radialibus 8–11, centralibus 4 teretibus cum infimo hamato radiales vix superantibus.

Along the middle course of the Rio Grande and near the Pecos and San Pedro rivers, on the mountains of the Limpia, and near Presidio del Norte, and southward into Mexico, but not as far west as El Paso ; Wright, Bigelow. Flowers June and July. — Heads $\frac{1}{2}$ to 2 feet high, but flowering often when not more than 2 inches high ; ribs usually 13 ; areolæ roundish in younger, more elongated in older specimens, often only 6–10 lines, but in vigorous plants 1–$1\frac{1}{2}$ inch apart. Spines glabrous, or only the lower central one scabrous pubescent ; lateral spines whitish ; all the others purplish or variegated, with paler semitransparent tips. The forms *β.* and *γ.* are those which occur in our territory ; they differ in the length and number of spines, but not at all in flower and fruit. In var. *β.* the lower and upper radial spines are 1–3 inches, the lateral ones 2–$3\frac{1}{2}$ inches long ; upper central spines 2–5, and lower one 3–$6\frac{1}{2}$ inches long. Var. *γ.* is perhaps the young plant, as these plants often flower when yet quite young, and before the character of the mature plant is yet fully developed. This in a very marked degree is the case with *E. uncinatus*, var., which begins to bloom while the central spine is yet quite short and terete. Lower radial spines in var. *γ.* $\frac{1}{2}$–$1\frac{1}{4}$ inch, upper ones $1\frac{1}{4}$–2 inches long ; lateral ones $1\frac{1}{4}$–$1\frac{1}{2}$ inch, and central spines all $1\frac{1}{2}$–2 inches long. Flowers form a groove just above the spines, separated from the spiniferous areola by 2–5 obtuse cylindric glandular bodies, which when young exude a clear viscous liquid. I find them also in *E. setispinus*, *E. Emoryi*, and [23] numerous others, and they correspond, no doubt, with the glands in the groove of *Mamillaria Scheerii* and others. They appear with the flower, and are soft and fleshy at that time ; afterward they become hardened, of the texture of the spines themselves, and are persistent. Flowers $2\frac{1}{2}$–$3\frac{1}{2}$ inches long, externally greenish-yellow and red, internally yellow, with a red base. Fruit 1–2 inches long, coated with 25 or 40 or more scales, crowded with the

remains of the flower, green and very acid (Bigelow), or insipid or sweetish when fully ripe (Parry). Seed larger than in the last species, 0.7–0.8 line in the longest diameter, deeply and distinctly pitted under the lens.

7. E. Wislizeni, E. in Wisliz. Rep., has been often collected, by the different gentlemen attached to the Commission, between Doña Ana and El Paso, and probably on the upper Gila, but not eastward. Small specimens show only 13 ribs; full-grown ones usually have 21 or even as many as 24 ribs. Areolæ from ½ to 1½ inch distant from one another; on older plants closer than on half-grown ones. Three lower radial spines annulated, stout, 8–20 lines long; 3 upper ones somewhat slenderer, but also annulated, 1½–2 inches long; in younger specimens these latter are wanting, in old ones they move more toward the centre of the areola and become surrounded by the upper bristly spines; lateral bristle-spines 15–20, 1½–2¼ inches long, often twisted, spreading horizontally. All the stouter and annulated spines are red, with paler semitransparent points; the weaker spines are yellowish-white. Ovary and fruit imbricately covered with 60 or 80 scales; fruit rather fleshy but not juicy, and soon hardening. Seed oblique obovate, 1.0–1.2 line long; hilum small, broadly oval, subbasilar, or sometimes almost ventral; surface of the seed finely reticulated under the lens; curved foliaceous cotyledons partly buried in the large albumen. (Tab. XXV.–XXVI.)

8. E. Le Contei, E. in Pacif. R. Report. This fine species, which was discovered by Dr. Le Conte on the lower Gila, and found again by Dr. Bigelow higher up on the Colorado, has been observed frequently by Mr. Schott in the western part of Sonora, where it flowers in August and September. The flowers, which had not been seen by any other observer, may be described thus:

Floribus plurimis subcentralibus; ovario squamis 30–50 sepaloideis reniformibus munito, sepalis tubi inferioribus 20–30 ovato-lanceolatis acutis ciliatis, superioribus 10–20 margine petaloideis obtusiusculis cuspidatis; petalis 20–30 lineari-spathulatis obtusis inciso-fimbriatis mucronatis sulphureis; tubo basi intus nudo; stylo stamina superante ad medium in stigmata sub-14 linearia fasciculata diviso. (Tab. XXVII.)

Mr. Schott's specimens were 3–4 feet high, clavate, and usually only one third as thick. Dr. Bigelow's specimens were not as slender. Flowers 2 inches in length, "somewhat campanulate;" petals "lemon-yellow," with a brownish tint along the midrib; tube naked for about one line above the base of the style.

9. E. Emoryi, E. in Emory's Rep., 1848: grandis, ovatus, glaucescens; costis 13–21 rectis obliquisve obtusis tuberculatis; areolis ovatis junioribus dense sordideque tomentosis; aculeis 8–9 subæqualibus robustis subangulatis annulatis paulo recurvis rubellis demum fuscis apice sub pellucido corneis, radialibus 7 seu (interdum adjecto aculeo tenuiore summo) 8, lateralibus sublongioribus, centrali singulo recurvo seu subhamato paulo robustiore; floribus magnis purpureo-variegatis; sepalis ovarii 25 reniformibus ciliolatis, superioribus spathulatis lanceolatis acutis; petalis sub-25 lanceolatis acuminatis versus apicem fibriato-fissis; stylo stamina vix superante profunde [24] 18–20-partito. (Tab. XXVIII.)

On the Gila, Emory; the lower Colorado, Bigelow; and in Sonora, at Punta de Agua, Sierra del Pajarito, Sierra de la Union, and Sierra de Sonoyta, Schott. Flowers in August and September. — Largest plants 30–36 inches high and 18–24 inches in diameter, with 20 or more ribs, smaller ones a foot in diameter and globose, only 13-ribbed. Ribs strongly tuberculated; tubercles quite distinct — especially on the younger plants — and rounded, on old plants more confluent. Areolæ 6–10 lines long, 1½–2 inches apart, oval, separated from the contiguous but smaller floral areola by 2–5 terete obtuse finally ligneous glands. Radial spines mostly 1–2 inches long, — in a very large specimen from Guaymas, on the Gulf of California, procured by Dr. Bigelow, and now in the Congressional Garden in Washington, nearly 3 inches long; the 4 upper lateral spines are the longest and stoutest; the lower ones, and if present the uppermost radial spine (in the specimen from Guaymas sometimes 2), are shorter and slenderer than the others. Flowers aggregated near the vertex, about 3 inches long, dark brown-purple outside; petals red, with yellowish margins; filaments rising from the thick and fleshy upper part of the short tube, leaving its lower part naked, extremely numerous; style thick, as long as the longer (exterior) stamina, divided to the middle into 18 or 20 filiform stigmata. Fruit and seed as yet unknown.

10. E. viridescens, Nutt.: globosus seu depressus, simplex seu e basi ramosus; vertice depresso tomentoso; costis 13–21 compressis vix tuberculatis; areolis orbiculato-ovatis junioribus tomentosis; aculeis compressis annulatis plus minus curvatis e virescente rubellis, radialibus 9–13 (18–20, ex Parry) infimo robusto breviore deorsum curvato, centralibus 4 robustioribus 4-angulatis compressis cruciatis, inferiore latiore longiore minus curvato; floribus subverticalibus e flavo virescentibus; ovario globoso squamis sepaloideis 25–40 semilunatis reniformibusve denticulatis imbricatis stipato; sepalis tubi 25–30 ovatis oblongisve obtusis; petalis 20 oblongis obtusis eroso-denticulatis; stylo usque ad medium in stigmata 12–15 linearia erecta albida diviso; bacca ovata seu subglobosa squamata virescente floris rudimentis coronata; seminibus oblique obovatis dorso carinatis minutissime scrobiculatis, hilo orbiculato parvo subventrali. (Tab. XXIX.)

San Diego, California, on dry hills and ridges, Nuttall, Parry; on the sea-beach, Schott. — According to Nuttall, this species is about 1 foot high, and has 9 or 10 inches diameter. Dr. Parry found them usually flat, 4 or 5 inches

high (above ground) and 6–7 inches in diameter. They are usually simple, but sometimes, "only when wounded or burned over by fires," they branch from the base, forming in favorable situations quite a pile of prickly balls. In a young specimen brought home by Dr. Parry, about 2 inches in diameter, with 8 ribs, I find only 9 radial slightly recurved spines, the lowest and most curved one 4–6 lines long, the 2 upper ones 6–8 lines and the 6 lateral ones 8–9 lines long; the 4 central spines are much stouter, more distinctly angular, compressed, and annulated, 10–16 lines long, the uppermost one more curved, the lowest one almost straight. Schott, in his notes made on the spot, states the number of radial spines to be 13, much shorter than the central spines; Parry describes the radial spines of the adult plant as 18–20, not more than 6–9 lines long, while the longest central spine is about 18 lines long. Flowers disposed in a circle around the vertex, greenish, 1½ inch long, 1¼ in diameter; tube inside naked at base; stamina short; style about 1 inch long, more deeply divided than in other species. Fruit 8–10 lines long, of the shape and taste of a gooseberry; bluish-green, in Parry's specimens with 25–30, in Schott's with 35–40 scales. Seed 0.8 line long, [25] very minutely but distinctly pitted.

11. E. CYLINDRACEUS, E. in Sillim. Journ. 1852, sub *E. viridescente:* ovatus seu ovato-cylindricus, simplex seu plerumque e basi ramosus; vertice breviter tomentello; costis 21 seu pluribus rectis seu obliquis obtuse tuberculatis; areolis ovatis; aculeis robustis compressis annulatis plus minus curvatis flexuosisve rubellis apice corneis, radialibus 12 sæpe cum aculeis gracilioribus sub-5 summæ areolæ insertis, lateralibus tenuioribus, infimo robusto breviori decurvato-hamato; aculeis centralibus 4 robustissimis 4-angulatis compressis cruciatis, superiore latiore sursum suberecto, inferiore deorsum curvato; flore flavo; bacca subglobosa carnosa pallide virescente sepalis semilunatis fimbriatis stipata, floris rudimentis coronata. (Tab. XXX.)

Rocky ravines near San Felipe, on the eastern slope of the California mountains, in latitude 33°, Dr. Parry; also seen by Dr. Le Conte. — Young plants globose, older ones ovate and cylindrical; the former have 13 ribs, the latter from 20 to 27. The largest specimens seen were 3 feet high and 1 foot in diameter. They often branch out at base, which by Dr. Parry is ascribed to the action of fire crippling the original stem. Ribs somewhat interruptedly tuberculated; tubercles flattened horizontally. In the youngest specimens are found already 7 radial and 4 central spines, the lower radial spine much the stoutest and quite curved; the 3 upper central spines almost radiating, the lower one erect, all stout, and 1–1½ inch long. In older specimens (the one before me is globose, 4 inches in diameter, with 13 ribs) the areolæ are 6–8 lines long, 3½–4 lines wide; the radial spines (together with the 3–5 slender additional ones on the upper edge of the areola) 12–18, — the lowest one is stout and much hooked and the shortest of all, the others are from 1½–2 inches long. The 4 central spines are 1–1½ line broad and about 2 inches long. In the most fully developed bunches of spines the 3 upper radial spines are pushed into the inner circle, so that then the number of centrals appears to be 7. The upper central spine is the broadest one, almost straight and erect; the lower one has mostly a strong downward curve. The fruit is described by Dr. Parry as a green, juicy berry, about an inch in diameter, in the axils of the uppermost spines, with yellow remains of the corolla; seed black, "intermediate in size between that of *E. viridescens* and *E. Wislizeni.*"

I was inclined to consider this plant as a form of *E. viridescens*, but Dr. Parry, who has seen numerous specimens of it, is satisfied that it is quite a distinct species. It is characterized by the cylindrical growth, more obtuse ribs, more numerous, longer, and more curved spines, of which the upper, not the lower one, is the largest and broadest. It is quite remarkable that we have three so similar species on both sides of the California mountains as the two just mentioned and *E. polycephalus*, — the western one globose, the two eastern ones cylindrical and many-headed; these entirely dissimilar in flower and fruit, and one of the eastern and the western one so much alike. It is an interesting observation that similar but quite distinct species occur on both sides of the mountains, not only in this genus, but also in *Mamillaria* and *Opuntia*, and that no species crosses that mountain range.

12. E. POLYCEPHALUS, Engelmann and Bigelow, in Pacific Railroad Report; found by Mr. Schott on the Gila and lower Colorado. He notes the cespitose growth, and the heads 5–8 inches in diameter, 10–15 inches long, with 10–15 ribs. Dr. Bigelow's specimens from the Mojave River were much larger; but the fruit sent by Mr. Schott leaves no doubt about their identity.

13. E. PARRYI, sp. nov.: simplex, globosus seu depressus; costis 13 acutis tuberculato-interruptis, sæpe obliquis; areolis orbiculatis, seu areola florifera contigua minore addita ovatis albo-tomentosis; aculeis omnibus [26] robustis annulatis plus minus compressis albidis, radialibus 8–11 rectis seu paulo curvatis, superioribus debilioribus, lateralibus robustioribus, infimo deficiente; aculeis centralibus 4 validioribus, 3 rectiusculis sursum versis, infimo valido longiore curvato deflexo; bacca sicca oblonga squamis aristatis spinescentibus tomentoque denso albo vestita floris rudimentis coronata. (Tab. XXXII. fig. 6–7.)

Desert region southwest of El Paso toward Lake Guzman, over an area of sixty or eighty miles in extent; found by Parry with old fruit in January, and by Wright and Bigelow without flower or fruit in April. — I have before me only a few bunches of spines; the other data are all obtained from Dr. Parry's notes. The plant is 8 or 12 inches high by 10 or 15 inches in diameter, always simple; the ribs interrupted; upper tubercles less distinct, flattened side-

wise, lower older ones transverse and very distinct; grooves between the ribs about an inch deep; areolæ of the spines ½ inch in diameter, orbicular, or with the closely adjoining floriferous areola oval, about ¾ inch long. Radial spines in my specimen 8 or 9, "often as many as 11;" lower ones divergent stoutest, upper ones more slender. Central spines 4, stouter and 1½–2 inches long, somewhat bulbous at base; upper and lower one, especially the last, stoutest and longest.

This species is nearly allied to the last; but even in the absence of seeds we can distinguish it by the simple globose or somewhat depressed heads and the white spines. I have named it after Dr. C. C. Parry, who, by his intelligent observations and copious notes about the *Cactaceæ* of the Boundary, has greatly assisted me in their elucidation.

14. E. HORIZONTHALONIUS, Lemaire, var. CENTRISPINUS: glaucus, depresso-globosus (vetustus sæpius ovatus umbilicatus); costis 8 obtusissimis latissimis; sinubus superficialibus acutis; tuberculis sulco transverso inconspicuo vix distinctis; areolis orbiculatis basi truncatis prominulis, junioribus albo-lanatis; aculeis 6–8 robustis compressis annulatis recurvatis rubellis demum cinereis, radialibus 5–7, superioribus debilioribus, infimo deficiente, centrali singulo robustiore latiore deorsum flexo; floribus ex vertice densissime lanato centralibus campanulatis; ovario tuboque lana longa dense vestito; sepalis exterioribus 60–70 subulatis linearibus et lanceolato-linearibus spinoso-aristatis atropurpureis nudis ex lana copiosissima axillari vix exsertis; sepalis interioribus sub-15 obovato-lanceolatis mucronatis axilla nudis; petalis sub-36 oblongis obtusis eroso-dentatis roseo-purpureis; stylo supra stamina numerosissima flava exserto rubello; stigmatibus 6–8 brevibus erecto-patulis; bacca rubra succosa mox desiccata lana densa involuta floris rudimentis spinescentibus coronata a basi fere persistente circumscissa decidua; seminibus subglobosis rugosis minutissime tuberculatis nigris opacis, hilo transverso ventrali; embryone exalbuminoso suberecto clavato; cotyledonibus brevissimis. (Tab. XXXI., XXXII., fig. 1–5.)

Stony soil on the summit of hills, from the Pecos to El Paso, and north to Doña Ana; Wislizenus, Wright, Bigelow, Parry. Flowers April and May, and "continuing to put out its beautiful flowers till July." — Easily distinguished by the broad obtuse ribs. The numerous specimens examined by me are all depressed, 1½–4 inches high and 2½–6 inches in diameter, but old specimens are said to be sometimes 6–8 inches high, oblong, and even cylindric. Ribs in very young specimens, 5; in all the flowering plants which I have seen, 8 and "sometimes 10"; in young plants the ribs are scarcely interrupted, but in older ones they are divided by more or less shallow grooves into very broad tubercles. Areolæ 6–10 lines apart, covered with long wool when young. Spines mostly 6–8, rarely 9, ¾–1½ inch (and usually 1 inch) long, nearly equal in length, very variable in shape and thickness, sometimes long and slender and almost terete, in other specimens short, stout, and broad. Flower 2½ inches long, of the [27] same diameter, open only in bright sunshine, light purple or pink; tube lighter colored; ovary very short (3 lines), globose; tips of sepals dark purple, protruding from the dense white wool which envelops the whole flower; stamens of a flower, counted by Mr. Wright, 1266. Berry juicy, but drying up very soon, and finally breaking off transversely, leaving the base with most of the seeds hidden in the thick wool. The seeds, even when fully ripe, look shrivelled, and are 1.2–1.5 line long; the large circular (or rather truncate and transverse) hilum is deeply immersed; embryo almost without albumen, and quite straight, with thick, very short, erect cotyledons, and a taper-pointed radicle.

Our plant seems to be a variety of *E. horizonthalonius*, which is described as having 7 straight radial spines, the lowest one a little longer than the others, and the flower pale rose-colored, with lanceolate-acuminate petals. Prince Salm's var. β. *curvispinus* seems still nearer to our plant, which has a decidedly central but no lower radial spine, just like the last and the next species; the space for the lower radial spine is covered and filled by the strongly deflexed central spine.

15. E. TEXENSIS, Hœpf. Not observed farther west than the San Pedro and Pecos rivers. Fruit red and juicy, drying up very soon; seeds 1.2–1.4 line long, somewhat reniform, with a deep indentation including the circular hilum; testa smooth and shining, rarely (in Berlandier's specimens from Matamoras named by him *Melocactus laciniatus*) indistinctly tuberculated; embryo curved or hooked, with the foliaceous cotyledons buried in the large albumen. (Tab. XXXIII.)

16. E. BICOLOR, Galeotti, var. SCHOTTII: simplex, ovatus vel ovato-cylindricus; costis 8 obtusis tuberculatis interruptis; areolis orbiculatis; aculeis radialibus 15–17 rectis, inferioribus brevioribus teretiusculis basi bulbosis rubellis variegatis, summis 2–4 longioribus latioribus compressis albidis; aculeis centralibus 4 albidis, summo latiore longiore supra plano infra carinato recto seu paulo sursum curvato, cæteris compressis seu subteretibus brevioribus rectis; floribus magnis in vertice tomentoso subcentralibus; ovario squamis sepaloideis 10–12 reniformibus margine ciliatis imbricato, sepalis tubi 40 sensim majoribus obtusis margine pallidiore ciliatis, summis oblongis; petalis purpureis; stigmatibus 8 suberectis.

On cretaceous hills, covered with chaparral (thorny bushes), near Mier, on the lower Rio Grande; Schott. In flower in September. — Stem 4–6 inches high, 2–3 in diameter; grooves rather shallow; floral areola close to the

spiniferous one, without the intervening glands which are so conspicuous in *E. longehamatus* and others, and which I find also in the Mexican forms of *E. bicolor*. The 4 upper radial spines about an inch long and flat; all the others rounded, red, paler at both ends; the lowest is the weakest and shortest one, and often somewhat curved: upper central spine 15–20 lines long; the three others shorter; the lower one flat above, rounded below, often reddish like the lower radial spines. Flower between 2 and 3 inches long; petals bright-purple or rose-purple, gradually paler in fading; filaments springing from the whole tube down to its base.

The original Mexican *E. bicolor* is distinguished by the more globose form, also by the smaller number of radial spines (10–11), and by the upper central spine not being carinate nor longer than the others.

17. E. INTERTEXTUS, sp. nov.: minor, ovato-globosus; costis 13 acutis interruptis subobliquis; tuberculis supra breviter tomentoso-sulcatis; areolis ovatis (in planta juniore angustioribus) approximatis; aculeis brevibus rigidis e basi albida rubellis apice fuscatis, radialibus 16–25 arcte adpressis intertextis, superioribus 5–9 setaceis [28] albidis rectis, lateralibus rigidioribus paulo longioribus infimoque robusto brevi sæpe paulo recurvatis; aculeis centralibus 4, superioribus radiales excedentibus sursum versis, inferiore brevissimo porrecto robusto; floribus parvis in vertice dense lanato congestis purpurascentibus; ovario brevissimo 5–6-squamato; sepalis tubi 20 late ovatis cuspidatis albo-marginatis; petalis 20–25 oblongis mucronatis; stylo stamina numerosissima vix superante; stigmatibus 7–8 purpureis erectis; bacca globosa sicca squamis evanescentibus subnuda basi subpersistente circumscissa; seminibus reniformibus circa hilum magnum orbiculare ventrale curvatis tenuiter verruculosis lucidis; albumine parco; embryone curvato; cotyledonibus foliaceis brevibus. (Tab. XXXIV.)

Var. β. DASYACANTHUS: ovatus seu conoideus; aculeis gracilibus longioribus e purpurascente cæsiis, radialibus 19–25 setaceis pluriserialibus, superioribus 7–9 gracilioribus brevioribus albidis fasciculatis, centralibus 4 vix robustioribus, superioribus 3 sursum versis reliquos excedentibus, inferiore porrecto paulo breviore. (Plate XXXV. figs. 1–5.)

On stony ridges from the Limpia to El Paso, Wright, Bigelow; and westward, Parry; also toward Chihuahua, Wislizenus. Var. β. common about El Paso. Flowers March and April. — Stems 1–4 inches high and a little less in diameter; areolæ 3 or 4 lines apart. Upper setaceous spines pale, 2½–6 lines long; lateral spines 4–7 lines, lowest only 2–4 lines long; upper central spines 5–7 and even 9 lines, lower one 1 or rarely 2 lines long: in young plants the 13–15 radiating spines are more equal in length, and several or all of the central spines are wanting. Flowers about an inch long and wide; sepals dark purple with paler margins; petals similar, outer ones deeper, inner ones gradually lighter colored; stamens more than 650, half as long as petals. Fruit about 4 lines in diameter, tipped by the withered flower, usually with a few dried scales, with or without some wool in their axils; the base usually persistent for some time, while the upper part comes off, separating more or less regularly. Seeds nearly or quite 1 line long, with a very large hilum.

Var. β. has the flowers and fruit of var. α., but is a larger plant, with much longer and slenderer spines; lower central spine almost as long as the others. Spines in var. α. appressed so that the plant resembles somewhat, and has been confounded with, *Cereus viridiflorus*. In var. β. the spines are loosely patulous, forming a tuft on the top. The whole plant is very similar to *M. dasyacantha;* the entire similarity of flower and fruit, and the intermediate forms of the spines, leave no doubt of both plants belonging together, though their external appearance is so very dissimilar.

III. CEREUS, HAW.

Subgen. 1. ECHINOCEREUS, E.[3]

1. C. VIRIDIFLORUS, E. in Wisliz. Rep., β. CYLINDRICUS: ovatus seu plerumque cylindricus, subsimplex; costis sub-13 acutis fere interruptis; areolis confertis ovatis seu ovato-lanceolatis, junioribus albo-villosis mox [29] denudatis;[4] aculeis 12–18 radialibus brevibus pectinatis rigidis, adjectis plerumque supra aculeis adventitiis

[3] This subgenus, which was indicated by me in the Appendix to Wislizenus's Report as a genus distinct from *Cereus*, and which Prince Salm, in the latest edition of his "Hortus Dyckensis," very properly reduced to a section of that genus, is well characterized by the peculiarities of the flower and fruit pointed out in the work above mentioned. The numerous species since discovered confirm this character. The seeds especially are distinct from those of any other *Cactaceæ* examined by me. They are rather small, never so much as 1 line (between 0.4 and 0.9 line) in length, obliquely obovate or subglobose, more or less compressed, and with a circular or oblong basilar or sub-basilar hilum; testa black, hard, and brittle, always tuberculated; its tubercles large or small, equal or unequal, distinct or more or less confluent, and then leaving irregular depressions, so that the seed appears pitted, or pitted and tuberculate together; embryo with little or no albumen, almost straight, or very slightly curved; the short, though distinct, and even somewhat foliaceous, transverse cotyledons more or less bent, inclined to form a hook.

[4] This *tomentum* or *villus* on the young or nascent areola is so universally present, always disappearing with age, that it ceases to be a character. The differences consist only in the greater density or looseness of this tomentum, and in its color, which is almost always white, but occasionally yellowish, gray, tawny, brown, or almost black. I shall only make mention of it where it varies from the ordinary form.

2–6 brevioribus setaceis, lateralibus longioribus, inferioribus purpureis demum fuscis, superioribus plerumque albidis, rarius omnibus purpureis; aculeis centralibus nullis seu rare singulo robusto recto vel subinde curvato apice seu toto purpureo-fusco, rarissime altero graciliore superiore adjecto; floribus versus apicem lateralibus e flavo virescentibus; ovario tuboque pulvillos 25–30 (aculeolis infra 8–12, supra 3–5 albidis seu rubellis munitos) gerentibus; sepalis interioribus lineari-oblongis 10–15 virescentibus fuscatis; petalis 12–15 lineari-oblongis acutiusculis; baccis ellipticis virescentibus; seminibus parvis obovato-subglobosis tuberculatis, hilo basilari suborbiculato. (Plate XXXVI.)

On the Limpia, and thence toward El Paso; Wright. Flowers in May. — This is a taller form than the original species, described in Wislizenus's Report, from the northern parts of New Mexico, with stouter spines and acute petals. A handsome plant, not so much on account of the inconspicuous flowers as from the beauty of the purple and white spines, which are particularly bright when first developed in spring, and look like flowers. Stems 3–6 and sometimes even 8 inches high, 1–2 inches in diameter. Spines usually 3–5 or nearly 6 lines long; central spines, if present, 6–10 lines in length, — more common on the smaller northern var. *a.*, rarely present in the southern form. In a single specimen collected by Dr. Bigelow on the upper Pecos I find on some of the areolæ all or most of the spines purple, and the central spine sometimes curved upward, sometimes white, with a purple tip, or purple to the base. Flower 1 inch or less below the top, 1–1¼ inch long, not quite as wide even when fully open; petals 2–3 lines wide. Fruit 5–6 lines long, crowned with the withered corolla, as in all *Echinocerei*. In some rather dry fruits the corolla is quite persistent; in the more juicy ones it, as well as the spines on the fruit, are deciduous when the fruit is quite ripe. Seed 0.5–0.6 line long, tuberculated, but the tubercles somewhat confluent, very slightly in the northern form, a little more in ours, so as to show pits between the warts; seed somewhat compressed, and keeled on the back.

2. C. CHLORANTHUS, sp. nov.: cylindricus, simplex seu e basi parce ramosus; costis 13–18 subinterruptis; areolis confertis orbiculato-ovatis; aculeis 12–20 laxius radiantibus setiformibus albis, lateralibus longioribus apice sæpe purpurascentibus, adjectis supra aculeolis 5–10 brevioribus setaceis; aculeis centralibus 3–5 quorum 2 superiores breviores plerumque purpurascentes sursum divergentes, 1–3 inferiores longiores divergentes deflexique albidi; floribus in caule medio vel inferiore lateralibus virescentibus extus rufis; ovario pulvillos sub-21 (aculeolis 14–18 setaceis munitos) gerente; sepalis tubi sub-18 lineari-lanceolatis, inferioribus aculeolos axillares 3–5 gerentibus; petalis 15–18 lineari-oblongis mucronatis; filamentis styloque sulphureis; stigmatibus 8–11 viridibus adpressis; bacca subglobosa aculeolata; seminibus parvulis tuberculato-scorbiculatis. (Tab. XXXVII.–XXXVIII.)

Common on stony hills and mountain sides near El Paso; Wright, Bigelow. Flowers April. — Stems 3–9 or 10 inches high, 1½–2 inches in diameter; areolæ 3 or 4 lines apart, not so much elongated as in the last species, and often almost orbicular. Radial spines slender, patulous, not strictly radiating, pectinate or adpressed to the plant; lower lateral ones the longest (as in all these *Pectinati*), 4–5 lines long, inferior ones shorter, upper ones shortest. No central spines are present in young plants, next 1–3 appear, and well-developed flower-bearing plants have [30] always 5; the upper darker and shorter ones are about 6 lines, the lower ones 9–12 or even 15 lines long; the lowest one is the longest, and regularly deflexed, so that the plant, seen from above, shows as many rays formed by these spines as there are ribs. Spines mostly white, the lower lateral and central ones often tipped with purple, upper central ones entirely purple; a specimen has been sent with all the spines almost entirely white. Flowers yellowish-green, always low down on the plant (usually below the middle, often in the lower third), forming a circle around the stem; flowers an inch long, funnel-shaped, not fully opening even in bright sunshine. Mr. Wright — to whose careful examinations and full notes I am indebted for many data — found the stamina about 400 in number and half as long as the petals; stigmata green, much exsert. Fruit half an inch or less in thickness, crowned with the conic remains of the flower. Seed 0.5 or 0.6 line in diameter, orbicular, compressed and carinate; tubercles confluent, so as to form pits; hilum linear-oblong or oval, basilar. Name from the color of the flowers.

3. C. DASYACANTHUS, E. in Wisliz. Rep.: ovatus seu subcylindricus, simplex seu e basi parce ramosus, subcæspitosus; costis 15–21 rectis seu obliquis subinterruptis; areolis confertis ovatis; aculeis 20–30 rectis rigidis patulis stellatim undique porrectis intertextis cinereis apice sæpe rubellis vel adustis, in plantis debilioribus albidis, exterioribus 16–24 quorum laterales longiores, superiores breves graciles, inferiores intermedii, interioribus 3–8 robustioribus; floribus sub vertice ipso subterminalibus magnis flavis; ovarii pulvillis 35–45 villosis aculeolos 15–18 albidos seu apice rubellos gerentibus; sepalis tubi late campanulati inferioribus 20–30 aculeoliferis, superioribus 15–20 petaloideis oblanceolatis acutis seu cuspidatis; petalis 15–25 spathulato-oblanceolatis mucronatis seu interioribus plerumque obtusis muticis; staminibus numerosissimis; stylo exserto subclavato; stigmatibus 13–18 viridibus erectis; bacca magna subglobosa aculeolata; seminibus subglobosis tuberculatis. (Tab. XXXIX., XL., XLI., fig. 1–2.)

About El Paso, and down to the cañon of the Rio Grande; common on rocky hills and the edge of gravelly table-lands, where Dr. Wislizenus first found it in 1846, and where the gentlemen connected with the Boundary Commission have since abundantly collected it in flower and fruit, and in numerous living specimens. — The geographical range of this species seems quite limited, as it has not been sent from any other locality but the one indicated. Flowers in April and May; fruit ripe in June. — Stems 5–12 inches high, 2 or 3 or even 4 inches in diameter, densely

covered by the innumerable ashy-gray or reddish spines. Lower lateral spines somewhat bulbous and compressed at base, 6–7 lines long, upper ones 3–4 lines, and lower ones about 5 lines long; upper central spines shorter than the lower ones, — these are the stoutest, and of about the length of the lower external spines, or a little longer. Flowers large and numerous from the upper axillæ of the past year's growth, before the growth of the same spring is much advanced, so that they appear terminal or central at first glance, as they cover the top of the plant. This is the case with many spring-flowering *Echinocerei;* others (*e. g.* the last-mentioned species) produce their flowers lower down on the plant from older axillæ. Flower 3 inches or more in length, and of the same diameter, very showy, externally greenish-yellow, with the centre of sepals red; petals bright-yellow; stamens, counted by Mr. Wright, over 1,700, with yellowish-green filaments; pistil stout; stigmata thick, erect. Flower (like those of most *Echinocerei*) open in bright sunshine only about the middle of the day, closing in the afternoon, but reopening the next or even the third day, unless the weather be very hot, when all the functions of the flower are performed in one day. Fruit [31] subglobose, 1–1½ inch in diameter, green or greenish-purple; when fully ripe, "delicious to eat, much like a gooseberry." Seeds 0.6 line long, subglobose, very little oblique, with an oblong basilar hilum, strongly and distinctly tuberculated, like those of *C. cæspitosus;* embryo almost straight, or rather the cotyledons slightly bent forward.

4. C. CTENOIDES, sp. nov.: subsimplex, ovatus; costis 15–16 obliquis subinterruptis; areolis lanceolatis confertis; aculeis rigidis albidis demum cinereis intertextis, radialibus 14–22 pectinatis basi bulbosa lateraliter compressis arcte adpressis sæpe subrecurvis, lateralibus longioribus, summis brevissimis, centralibus 2–3 raro 4 uniseriatis abbreviatis robustis basi bulbosis; floribus versus apicem lateralibus campanulatis flavis; ovarii ovati pulvillis sub-40 aculeolos 12–16 breves setaceos albidos seu apice fuscatos gerentibus; tubi campanulati sepalis inferioribus 30 squamiformibus ad axillas setis 3–10 munitis, sepalis interioribus 12–15 lanceolatis acutis, intimis obtusis, omnibus mucronatis; petalis 25–30 spathulatis obtusis retusis vel obcordatis denticulatis flavis basi angustata virescentibus; filamentis numerosissimis virescentibus brevibus; stylo albido; stigmatibus 10–12 obtusis erecto-patulis viridibus. (Tab. XLII.)

From Eagle Pass to Santa Rosa (Bigelow); on the Pecos (Wright). Flowers June and July (in St. Louis). — Stems 2–4 inches high, 1½–2½ inches in diameter. Aspect of plant very similar to *C. pectinatus*, to which I allude by the Greek name of the same meaning. Areolæ about 1 line long, also about 1 line apart. Spines whitish or ashy, and in some specimens with light-brown tips. Sometimes I find only 14–16 radial spines (1 upper, 1 lower, and 6–7 pairs of lateral ones); the older and larger ones have 7–9 pairs of lateral spines, 1 lower one, and often 3–5 small bristly upper spines. Upper spines ½–1 line, lower one 1–2 lines, and the others 3–4 lines long; central spines in a single longitudinal series one above the other, 1–3 lines long. Flower bright yellow, with a light-green centre and dark-green stigmata, open from eight or nine till one o'clock, 2½–3¼ inches long, 2½–3½ inches in diameter, the broad and obtuse petals forming an even uninterrupted margin all around; ovary with 38–44 pulvilli, scales obsolete, wool short, bristles about 15 in each bunch, 2–3 lines long; pulvilli of tube 25–35, with green fleshy sepals, the lower ones with 8–10 short, and the upper ones with 3–4 longer (5–6 lines long) bristles; petals 1½–1¾ inch long, ½ inch wide, lower part of the tube narrow, and for about 1½ line, naked inside; filaments very numerous and very slender; anthers small, pale-yellow; stigmata rather slender, 3 lines long.

Our plant looks distinct enough from *C. dasyacanthus*, which is taller, has a larger number of ribs, rounder and shorter areolæ, patulous and usually more numerous spines, and more and longer central ones, also flowers almost vertical, with stouter spines on their tube; but it may, after all, be only a form of it, just as *Echinocactus intertextus* and *E. dasyacanthus* belong together, and as *C. viridiflorus* and *C. chloranthus* may be joined: intermediate forms, however, have not yet been observed. It has already been stated that the flowerless plant so closely resembles *C. pectinatus* that it can hardly be distinguished from it except by the fewer ribs. The color of the flowers, to be sure, is very different; but though no instance is yet known among *Cerei* where yellow and purple flowers are found in the same species, this may not be impossible, and we may possibly have to unite all these forms.

5. C. PECTINATUS, E., var.? RIGIDISSIMUS: ovato-cylindricus; costis 20–22 interruptis; areolis lineari-lanceolatis confertissimis, junioribus parce lanosis; aculeis omnibus radiantibus arcte adpressis subrecurvis e basi bulbosa subulatis acutissimis rigidissimis albidis flavidis rubellisve subpellucidis, lateralibus 12–16 longioribus robustioribus, infimo singulo vix breviore, superioribus 3–6 setaceis brevibus fasciculatis; floribus sub vertice lateralibus; [32] ovarii pulvillis 50–60 aculeolos 8–12 rigidos gerentibus; sepalis tubi 40 inferioribus subulatis ad axillam aculeiferis, superioribus 20 lanceolatis acuminatis; petalis sub-20 spathulatis acutiusculis inciso-dentatis purpureis; stigmatibus sub-12; bacca ovato-globosa aculeolata; seminibus tuberculatis.

In the Sierras of Pimeria Alta in Sonora, and farther west (A. Schott). Flowers June and July. — Stems 4–8 inches high, 2 inches in diameter. Areolæ 2–2½ lines long in the larger full-grown specimens, 3 or 4 within 1 inch of the rib; in a small specimen, with only 15 ribs, smaller areolæ, and smaller and more numerous spines (30–35, only 1–1½ line long), 12 or more bunches of spines are crowded within the same space. Spines all radiating and

interlocking, extremely rigid and acute, variegated, the latest ones of each season being rose-colored, and the earliest ones a pale yellowish, thus forming variegated rings around the stem ; lateral spines 3–4½ lines long, lower one 2 lines long, upper ones still shorter. Flowers near the depressed vertex, just on the outer edge of the rounded top, 2½–3 inches long, bright-pink or purple. Fruit subglobose, nearly an inch long, pulpy and edible ; the fleshy part of the stem is also eaten by the inhabitants, who call this plant "cabeza del viejo." Seed (not quite ripe) 0.6 line long, strongly tuberculated, closely resembling that of *C. cæspitosus*.

I can distinguish this plant from *C. pectinatus* only by the greater rigidity and thickness of the radial and the entire absence of the central spines. The forms allied to *C. pectinatus* are very difficult to distinguish, and it is quite probable that they may run into one another, as Dr. Poselger — who has seen thousands of them in Texas and northern Mexico — is inclined to think. I find that *C. pectinatus* has always a distinct single inferior spine, which is only a little shorter than the lower lateral spines ; while *C. cæspitosus* has generally several of the lowest spines much shorter and weaker than the lateral ones. *C. adustus*, the flower of which is not yet known, has fewer ribs, oval areolæ, and the lowest spine much as in *C. pectinatus*.

6. C. CÆSPITOSUS, E. in Plant. Lindh., which extends from the Arkansas River to Saltillo, has been found by Mr. Wright as far west as the Nueces and the San Pedro. The loose darkish wool and slender bristles on the extremely numerous (80–100) pulvilli of the flower-tube, and especially the position of these pulvilli, — not in the axil, but considerably above it, on the sepal, just below its foliaceous tip, — distinguish this species from the nearly allied *C. pectinatus*, as well as from all other *Echinocerei* known to me. This structure of the sepals seems to imitate and explain the morphology of the tubercles in *Mamillaria*, demonstrating them not to be a branch or an axis, but the fleshy petiole of an abortive or depauperate leaf, which sometimes is indicated by an indistinct scale above the fasciculus of spines, or by the point of the tubercle of an *Anhalonium*.

This species has 12–18 ribs, 20–30 radial spines, rarely with 1 or 2 central ones here and there ; flower 2–3 inches in diameter ; petals sometimes though rarely curly, as in our figure, mostly plain ; stigmata 12–18 ; fruit 9–10 lines long, oval, generally bursting irregularly ; seed 0.6–0.7 line long, obovate, oblique, sometimes almost globose, very strongly tuberculated, with an oval hilum. The name *C. cæspitosus*, which would apply much better to a number of other species of this section, was given before any of these were known. It not inaptly represents a common state of the plant when it makes 5–12 heads, but not rarely it is almost or quite simple. (Tab. XLIII.–XLIV.)

7. C. LONGISETUS, sp. nov. : subsimplex, ovato-cylindricus ; costis 11–14 interruptis tuberculatis ; areolis orbiculatis ; aculeis setaceis flexilibus albis patulis, radialibus 18–20 rectis basi bulbosa compressis, superioribus [33] tenuioribus brevioribus, inferioribus longioribus, centralibus 5–7 bulbosis, quorum superiores radialibus vix longiores, 1–3 inferiores elongati divaricati deflexi sæpe flexuosi. (Tab. XLV.)

Mountains about Santa Rosa, in Coahuila (Bigelow). — Stems simple, or somewhat branching at base, 2–3 inches in diameter, 6–9 inches high ; ribs fewer, more distinctly tuberculated, and less compressed than in most other species, and easily distinguished thereby, and by the orbicular areolæ, from the otherwise similar-looking, pale-spined forms of *C. chloranthus*. Upper radial spines 2½–3 lines, lowest and lateral ones 6–7 lines long ; upper central spines hardly longer than these ; lower central ones always 3 in well-developed plants, 1½–2 or even 2¼ inches long. Flower and fruit of this peculiar and pretty plant as yet unknown ; the former said to be red. Name from the length and slenderness of the spines.

8. C. RŒTTERI, sp. nov. : ovato-cylindricus ; costis 10–13 interruptis ; areolis ovato-orbiculatis subconfertis ; aculeis e basi bulbosa subulatis rubellis apice obscuris demum cinereis, exterioribus 8–15 additis sæpe supra aculeis setaceis, lateralibus longioribus, infimo singulo breviore ; aculeis centralibus 2–5 robustioribus plerumque subbrevioribus ; floribus sub vertice lateralibus magnis purpureis ; ovarii pulvillis 20–24 aculeolos 10–15 albidos fuscatosve gerentibus ; sepalis tubi inferioribus aculeoligeris sub-15 triangulari-lanceolatis, superioribus 8–10 oblanceolatis spathulatis ; petalis 8–12 spathulatis ; tubo intus basi nudo ; stigmatibus 10–12 viridibus suberectis stamina numerosissima brevia longe superantibus ; bacca subglobosa ; seminibus oblique obovatis compressis inæqualiter tuberculatis subscrobiculatisque, hilo basilari parvo oblongo. (Tab. XLI. fig. 3–5.)

Sandhills south of El Paso (Bigelow) ; near El Paso or Frontera (Wright). Flowers April. — A single living specimen, preserved in the Congressional Garden in Washington, is 5 inches high and 2½ in diameter, and has 12 ribs. Areolæ in this and the dried specimens are 4–6 lines apart. Lower lateral spines 5–7 or 8 lines long, lowest one a little shorter, upper ones 2–3 lines in length ; central spines usually only 4–6 lines long, rarely one or the other longer, always stouter than the others, and with very thick and bulbous bases. Flowers 2½–3 inches long, purple, very similar to the flower of *C. Fendleri* or *C. enneacanthus* ; fruit 8–10 lines long and rather less in diameter ; seeds 0.7 line long, strongly but irregularly tuberculated ; tubercles here and there somewhat confluent.

In the arrangement of its spines this species considerably resembles *C. dasyacanthus*, and I have formerly taken it for a smaller variety of that species ; but it differs from it by the smaller number of ribs, the fewer and stouter spines, — which place it almost intermediate between the *Pectinati* and the *Decalophi*, — the red flower, the small

fruit, and the larger and irregularly tuberculated seed. I take great pleasure to acknowledge my indebtedness to the modest and faithful artist, Mr. Paulus Rœtter, who has adorned this memoir by his skilful pencil, by naming this species after him.

9. C. FENDLERI, E. in Plant. Fendl.: simplex, seu parce e basi ramosus, ovatus seu ovato-cylindricus, perviridis; costis 9–12 rectis seu obliquis tuberculato-interruptis; areolis orbiculatis, junioribus dense tomentosis subconfertis; aculeis basi bulbosis, radialibus 7–10 rectis seu sæpe curvatis, inferioribus robustioribus, infimo 4-angulato albido, sequentibus 2 obscuris, cæteris albidis seu sæpius fusco-variegatis, superioribus tenuioribus pallidis, summo deficiente seu robusto elongato curvato; aculeo centrali valde bulboso teretiusculo elongato fusco-atro sursum curvato rarissime deficiente; floribus magnis purpureis subverticalibus; ovarii tubique pulvillis 25–35 aculeolos 3–12 albos sæpe adustos gerentibus; sepalis interioribus 12–15 lineari-lanceolatis seu spathulatis acutis seu [34] cuspidatis; petalis 16–24 oblongo-linearibus seu obovato-spathulatis acutis seu obtusis mucronatis sæpe erosodenticulatis; stigmatibus 12–16 stamina numerosissima vix superantibus erectis; bacca ovato-globosa ex viridi purpurascente pulvillis aculeolatis 18–20 stipata; seminibus oblique obovatis curvatis paulo compressis scrobiculatis (tuberculis irregulariter confluentibus), hilo ovato seu subcirculari basilari; embryone paulo curvato. (Tab. LI.–LIII.)

In various situations, among rocks or in alluvial river-bottoms from Santa Fé (Fendler) to the cañon of the Rio Grande below El Paso (Wright, Bigelow), and from the country fifty miles east of the upper Pecos westward to Zuñi and the Aztec mountains (Bigelow) and to the Copper-mines (Thurber). Flowers May and June. — Stems single or few together, 3–8 inches high, 2–3 inches in diameter, not many together, and those usually of unequal height, not level-topped, like *C. phœniceus* and others; areolæ 4–7 lines apart. Spines very variable, but always characterized by their bulbous base, by the lower ones being stouter and longer than the upper ones, partly white and dark, and by the long and dark central spine, which is always curved upward. Radial spines mostly 7; a white and angular one below, 6–12 lines long; the two next ones hardly longer, more terete, black on the upper and usually white on the lower surface; then comes a pair of white or rarely variegated spines, scarcely shorter; above them two weaker, whiter, and shorter spines, 3–6 or 7 lines long. This is the usual form, especially in the north; often, however, two more upper spines are found, and sometimes a slender, or oftener a stout and dark-colored spine, not rarely 12–15 lines long, is placed on the upper edge of the areola, similar to but always smaller than the central spine. All these forms are occasionally seen on the same specimen. In some southern specimens I observe now and then a few small additional upper spines. The form which I have described in *Plant. Fendlerianæ* as *β. pauperculus*, and which Dr. Bigelow collected also on the Pecos, has mostly only 6 spines, — 5 lower and lateral radial ones and the central one, which more or less assumes the place of the absent upper radial spine. This, however, is not a constant form, as transitions to the usual arrangement of spines are often seen on the same specimen. Central spine very much thickened at base, almost terete, black, often with a lighter tip, curved upward, 1–2 inches long. Flower $2\frac{1}{2}$–$3\frac{1}{2}$ inches long and wide, not fully open before noon, closing again after two o'clock. Spines on the ovary $2\frac{1}{2}$–4, on the upper part of the tube 4–8 lines long, distinctly bulbous at base, and often angular; petals 4–7 lines wide, acute or obtusish; stamina about 1,600 in a specimen examined by Mr. Wright, only from the upper and wider part of the tube, the lower and narrow part 3–4 lines long, naked. Fruit 1–$1\frac{1}{4}$ inches long, purplish-green, edible. Seeds 0.7 line long, very oblique, irregularly pitted, by the tubercles, as it were, running together in twisted lines.

10. C. ENNEACANTHUS, E. in Wisliz. Rep.: ovato-cylindricus, obtusus, læte viridis, simplex seu plerumque dense cæspitosus; costis 7–10 obtusis infra dilatatis sursum compressis tuberculatis sulco transverso sæpe interruptis, sinubus profundis acutis; areolis orbiculatis remotis; aculeis rectis, radialibus 7–12 (plerumque 8) albis subpellucidis, inferioribus longioribus, centrali singulo (raro 2 superioribus tenuioribus additis) basi bulboso teretiusculo seu plerumque plus minus compresso triangulatoque albido stramineo seu obscuriore radialibus longiore; floribus subterminalibus seu lateralibus; ovarii pulvillis 25–35 in squamæ triangularis axillis villosis aculeolos 6–12 albidos seu fuscatos gerentibus; sepalis tubi inferioribus 18–20 cum aculeolis longioribus paucioribus, superioribus 10–18 oblanceolatis acutis; petalis 12–15 oblongo-obovatis erosis obtusis acutisve; stigmatibus 8–10 viridibus elongatis erectiusculis; bacca subglobosa e purpureo virescente; seminibus minutis obovatis subobliquis tuberculatis, hilo [35] oblongo. (Tab. XLVIII. fig. 2–4, et Tab. XLIX.)

Along the Rio Grande, from El Paso (Wright, Parry) to Eagle Pass (Schott, Bigelow), and into Mexico (Wislizenus). Flowers April and May. — A widespread species, assuming many forms, sometimes approaching the next. Stems generally branching and cespitose, 3–6 inches high, $1\frac{1}{2}$–2 or $2\frac{1}{2}$ inches in diameter, fresh green, in winter often reddish, even when in full growth appearing flaccid or shrivelled; areolæ 6–10 lines apart. Spines remarkably transparent, much smaller on the lower part of the plant than on the upper one, all bulbose at base, especially the central ones; upper radial spines 3–5 lines, lateral ones 5–12 lines, lower ones 8–16 lines long, all usually less than 1 inch; in some specimens the radial spines are almost equal in length, in others they differ very much. Central spine extremely variable in color, size, and shape; when young usually yellowish or brownish, at last ash-colored; in

younger plants terete; in perfectly developed ones triangular and flattened, 8 or 10 to 15 or 20 lines long: sometimes we find one or two additional shorter and angular central spines above the principal one, diverging upward. Flowers 2–3 inches long, and of the same and even greater width when fully open. The smallest were obtained at Eagle Pass, bright purplish-red; these have more numerous as well as slenderer and shorter spines on the ovary, and bloom earlier. The larger flowers come from El Paso and Chihuahua, from larger plants with longer spines. Berry 10 or 12 lines long, greenish or purplish, pleasant to eat. Seed 0.5 line or less in the longest diameter; its tubercles very prominent and distinct.

11. C. STRAMINEUS, sp. nov.: ovato-cylindricus, versus apicem attenuatus, læte viridis, cæspitosus densissimeque agglomeratus; costis 11–13 sursum compressis obtusis tuberculatis transverse sulcatis; areolis orbiculatis remotis; aculeis radialibus 7–10 (plerumque 8) rectis seu paulo curvatis basi bulbosis teretibus seu inferioribus subinde angulatis albis subpellucidis subæqualibus; aculeis centralibus subquaternis basi bulbosis angulatis elongatis radiales longe excedentibus sæpe flexuosis stramineis fuscatis, nascentibus sæpe roseis seu purpureis, superioribus sursum divergentibus, inferiore latiore porrecto seu paulo deflexo; floribus lateralibus grandibus; ovarii squamis 30–40 triangularibus et sepalis tubi late campanulati 20–30 inferioribus oblongis abrupte cuspidatis in axilla villosa aculeolos paucos flexuosos elongatos gerentibus; sepalis superioribus 10–15 oblongo-obovatis obtusis seu cuspidatis; petalis 15–18 late obovatis obtusis eroso-denticulatis; stigmatibus 10–13 elongatis erecto-patulis; bacca ovato-subglobosa magna purpurascente aculeolis elongatis numerosis deciduis armata; seminibus obovatis obliquis tuberculatis; hilo oblongo parvo; cotyledonibus subcurvatis. (Tab. XLVI.–XLVII., et Tab. XLVIII. fig. 1.)

On high gravelly table-lands, and on the mountain slopes about El Paso, extending east to the Pecos and west to the Gila (Wright, Bigelow, Parry). Flowers June; fruit ripe in July and August. — A most remarkable plant, on account of the immense masses it forms, one plant often consisting of 100 or 200 heads in a regular hemispherical mass, which is covered and defended by the long, flexuous, straw-colored spines: these have suggested the specific name of the plant. Single heads 5–9 inches high and 2–3 inches in diameter, tapering toward the top, at base closely impacted together; areolæ in vigorous plants $\frac{3}{4}$–1 inch apart, in older plants becoming more approximate. Radial spines $\frac{3}{4}$–$1\frac{1}{4}$ inch long, on the lower part of the plant shorter; central spines 2–3 or even $3\frac{1}{2}$ inches long, straight or variously twisted, and the younger ones red or brown. Flower 3 or 4 inches in length, and spreading as wide or wider, appearing very full from the broad (8–12 lines) and numerous petals of a bright-purple or deep-pink [36] color, inclining to crimson. Ovary with only few spines (2–4 lines long) on each pulvillus; the spines on the tube more numerous and about twice as long. These spines increase in number and length during the growth of the fruit, so that at maturity we find 8 or 10 in each fascicle, $\frac{1}{2}$ to 1 inch in length. Fruit $1\frac{1}{2}$–2 inches long, $1\frac{1}{2}$ inch thick, readily shedding the spines; purple; of a delicious taste, intermediate between a strawberry and a gooseberry. The small seeds (0.5–0.7 line long) cannot be distinguished from those of the last species. The tubercles are large for the size of the seed, and very distinct.

12. C. DUBIUS, sp. nov.: ovato-cylindricus, pallide viridis, cæspitosus; costis 7–9 obtusis tuberculatis; sinubus latis parum profundis; areolis orbiculatis remotis; aculeis albidis subpellucidis, radialibus 5–8 teretibus seu subangulatis, superioribus sæpe deficientibus, centralibus 1–4 bulbosis angulatis elongatis rectis seu incurvis; floribus lateralibus; ovarii pulvillis 20 in squamæ triangularis axilla parce villosa aculeolos paucos breves gerentibus; sepalis tubi inferioribus 16–20 ovato-lanceolatis cum aculeolis 1–3 longioribus; sepalis superioribus sub-10 oblongo-spathulatis obtusis; petalis sub-10 spathulatis obtusis pallide purpureis; stigmatibus 8–10; bacca subglobosa virescente-purpurea fasciculis aculeolorum 8–12 elongatorum deciduis armata; seminibus globoso-obovatis obliquis confluento-tuberculatis, hilo circulari. (Tab. L.)

Sandy bottoms of the Rio Grande, and from El Paso (Wright, Bigelow) to below Presidio (Parry, with Algarobia, Fouquiera, and Larrea). Flowers June and July. — Stems 5–8 inches high, not so densely cespitose as the last one, of a pale-green color and soft flabby texture; ribs few, broad; grooves shallow. Radial spines 6–12 or 15 lines long, lower ones longer than upper ones, or the upper spines very commonly entirely wanting, and replaced by the 3 upper central ones; central spines $1\frac{1}{2}$–3 inches long, the lower one somewhat stouter and longer than the upper ones. Flower $2\frac{1}{2}$ inches long, of the same diameter; petals fewer and narrower than in the last species, only 6 lines wide, paler (rose-colored), and mostly quite obtuse and almost entire; ovary in this as in the last species remarkably small and undeveloped while the flower is fully open, its spines few and short, growing afterward in length and numbers more than is noticed in any other species. Ripe fruit 1–$1\frac{1}{2}$ inch long, with 20–24 pulvilli, on each of them 9–12 bristly spines 4–9 lines long; fruit green or rarely purplish, insipid or pleasantly acid. Seed larger than in the two last species, 0.6–0.7 line long, subglobose-obovate, with a circular hilum; the tubercles not distinct as in the others, but confluent, and forming pits in the interstices.

These three species are very nearly allied, but are said to be easily distinguished in their wild state. The characters given above are said to be quite constant, and seem to establish them as good species.

13. C. ENGELMANNI, Parry in Sillim. Journ. 1852, n. ser. 14, p. 338: ovato-cylindricus, e basi parce ramosus;

costis 11–13 interruptis; areolis orbiculatis subconfertis, junioribus villosis; aculeis radialibus 13 sub-angulatis albidis apice adustis rectis seu paulo curvatis, lateralibus 6 longioribus, inferioribus 3 vix brevioribus, superioribus sub-4 parvis; aculeis centralibus 4 angulatis gracilibus rectis multo longioribus, inferiore longiore albido porrecto seu deflexo, superioribus fulvis arrectis; floribus sub apice lateralibus; ovarii pulvillis sub-30 aculeolos rigidos 8–14 gerentibus; sepalis tubi inferioribus 15–20 ovato-lanceolatis ad axillam villosam aculeiferis; petalis purpureis; stigmatibus 12 erectis viridibus; bacca ovata; seminibus oblique obovatis tuberculato-foveolatis, hilo subbasilari oblongo. (Tab. LVII.)

Mountains about San Felipe, on the eastern declivity of the California Cordilleras (Parry); common in the [37] Gila valley, especially near the Casa Blanca, above the Pimas village (Schott). Flowers in June.—Loosely cespitose, not more than 4 or 6 or at most 8 stems together; stems 5–10 or even 12 inches high, 2–3 inches in diameter. Radial spines 3–6 lines long; central ones 1–2 inches long, upper one the shortest, lower one the longest. Flower rather low down on the plant, between 2 and 3 inches long. Fruit at last naked, fleshy, 1½ inch long, 1 inch in diameter. Seed 0.6–0.7 line long, similar to that of *C. Fendleri*, its tubercles running together and forming irregular pits.

14. C. POLYACANTHUS, E. in Wisliz. Rep.: ovato-cylindricus, plerumque ramosissimus, cæspitosus, glaucescens; costis 9–13 subcompressis obtusis interruptis; areolis suborbiculatis remotiusculis seu demum confertis; aculeis teretibus robustis rigidis rectis albidis seu e cinereo rubellis apice obscuris demum totis cinereis, exterioribus 8–12 parum bulbosis, lateralibus longioribus, centralibus 3–4 bulbosis paulo robustioribus æquilongis seu longioribus, junioribus sæpe corneo-fuscoque variegatis; floribus sub vertice lateralibus diu noctuque apertis; ovarii pulvillis 16–20 tomentosis aculeolos 6–15 variegatos gerentibus; sepalis tubi inferioribus 10–12 triangulari-lanceolatis aculeiferis, superioribus lineari-lanceolatis seu oblanceolatis spathulatisve mucronatis seu summis obtusis; petalis 18–22 spathulatis obtusis integris seu erosis chartaceis coccineis basi pallidioribus erecto-patulis; tubo intus basi nudo, staminibus brevibus; stylo exserto; stigmatibus sub-8 erectis; bacca subglobosa; seminibus majusculis irregulariter tuberculatis; hilo subbasilari parvo angusto; embryone parcissime albuminoso; cotyledonibus brevibus incurvis. (Tab. LIV.–LV.)

A common plant at El Paso (Wright, Bigelow, Parry, Thurber), and as far south as the mountains west of Chihuahua (Wislizenus), on table-lands and mountains, and also on sand-ridges or stony hills. Flowers in March and April; fruit in June.—Heads 5–10 inches high, 2½–4 inches in diameter, pale-green or glaucous; areolæ ½–1 inch apart. Spines very variable; exterior ones not strictly radiating, but spreading; upper ones about 6 lines, lateral and lower ones 9–12 lines long; central spines in young specimens single, in older and more perfect ones always 3–4,—in some hardly longer than the radial ones, 9–12 lines long, but usually longer, and sometimes 2 or even 2½ inches long; lower central spine always longer than the others. Flowers 2–3 inches in length, spreading not quite so wide, remaining open day and night, often for four or five days, and profusely adorning the plant for four or six weeks in succession; petals rigid and somewhat concave, rounded, of a deep-red or blood-color; the base of the tube inside naked for 3 or 4 lines; stamens about 600; berry ¾–1¼ inch long, greenish-purple, of a pleasant gooseberry taste. Seeds larger than in any other *Echinocereus* known to me, 0.8–0.9 line long, oblique; hilum small, subbasilar; embryo with some albumen (which is not common in this genus), large, a little curved; cotyledons almost foliaceous, approaching the form observed in the cylindric *Cerei*.

15. C. PAUCISPINUS, sp. nov.: ovatus seu ovato-cylindricus, perviridis, simplex, seu parce ramosus, costis 5–7 interruptis; sulcis latis sursum acutis; areolis remotis; aculeis 3–6 seu rarius 7 robustis basi bulbosis rectis seu subrecurvis radiantibus, infimo pallidiore, cæteris rufis fuscisve, omnibus demum nigrescentibus, centrali nullo seu rarius singulo robusto subangulato atrofusco sursum verso seu porrecto; seminibus obovatis obliquis subconfluento-tuberculatis, hilo basilari elliptico. (Tab. LVI.)

From the San Pedro to the mouth of the Pecos, on rocks and gravelly limestone hills (Wright, Bigelow).— Stems 5–9 inches high, 2–4 inches in diameter, not cespitose like the last species, to which it seems to be allied, [38] but either simple or with few branches from near the base; ribs few, grooves wide and shallow; areolæ 8–10 lines apart; spines few and dark-colored, 9–15 lines long, upper one often shorter, and central spine when present 15–20 lines long; flower and fruit unknown. The seed sent by Mr. Wright is similar to that of *C. polyacanthus*, 0.7–0.8 line long, oblique, with slightly confluent irregular tubercles, and a large and wide hilum.

This species on the Pecos seems to take the place of the more western *C. polyacanthus*, which farther east is represented by *C. Rœmeri*, and farther west by *C. phœniceus*. From all these it is distinguished by the few ribs and the few dark spines.

16. C. BERLANDIERI, sp. nov.: humilis, perviridis; caule subtereti articulato-ramosissimo; tuberculis conicis distinctis 5–6-fariis; areolis parvis orbiculatis; aculeis tenuibus subsetaceis, 6–8 brevibus radiantibus albidis, 1 centrali plerumque multo longiore fuscato; floribus lateralibus magnis purpureis; ovarii pulvillis sub-20 breviter albotomentosis aculeolos capillaceos basi bulbosos 8–10 longiores albidos et 1–2 robustiores fuscos gerentibus; sepalis tubi

exterioribus 8–10 aculeoliferis, superioribus 13–16 oblongo-linearibus acuminatis seu cuspidatis; petalis 14–18 late linearibus seu lineari-oblanceolatis elongatis fere loricatis mucronatis apice denticulatis patulis demum reflexis; stigmatibus 7–10 viridibus; bacca ovata viridi subsicca; seminibus parvis obovato-subglobosis tuberculatis, hilo circulari. (Tab. LVIII.)

On the Nueces, Berlandier. Frequently in cultivation in St. Louis, Cincinnati, etc., under the wrong name of *C. repens* or *C. Deppii*, doubtless introduced from southern Texas. Flowers in May and June. — A spreading and procumbent plant, with erect branches contracted at base, and thereby articulated, 1½–6 inches long, ¾–1 inch thick, either terete with distinct spirally disposed tubercles, or the tubercles arranged in 5 or 6 ribs. Areolæ 4–6 lines apart. Radial spines bristle-like, weaker than those of the next species, 4–5 lines long, sometimes a stouter and darker one at the upper end of the areola; central spine yellowish-brown, shorter on the lower part of each branch, longer toward the top, from 5–6 to 10–13 lines in length. Flower 3–4 inches long, or when fully open spreading almost 4 inches, and only 2 inches in height; bristles of the tube below 2–3 lines, upward 4–6 lines long, the tomentum white and short; petals long and narrow, 3–4 or rarely 5 lines wide, bright rose-purple; filaments short, pale rose-colored; stigmata long and suberect. Berry about 9 lines long, densely covered with the elongated, mottled, hair-like spines. Seeds 0.5 line long, strongly and distinctly tuberculated, contracted at base. Nearly allied to *C. pentalophus*, DC., which, however, is an erect plant.

Named for Dr. J. L. Berlandier, who made known this as well as many other plants of the lower Rio Grande.

17. C. PROCUMBENS, E. in Plant. Lindh. 1850: humilis, perviridis; caule subtereti seu 4–5 angulato articulato-ramosissimo; tuberculis distinctis spiralibus seu 4–5 fariis; areolis parvis orbiculatis; aculeis rigidis brevibus albidis apice fuscis, 4–6 radiantibus, centrali nullo seu singulo paulo longiore obscuriore; floribus sub apice ramorum lateralibus magnis; ovarii pulvilli sub-25 albido-villosis aculeolos rigidos 6–9 breves variegatos gerentibus; sepalis tubi exterioribus 12–15 aculeoliferis, superioribus sub-15 lineari-lanceolatis acuminatis; petalis 18–20 lineari-spathulatis acutis seu obtusis, integris seu plerumque eroso-dentatis patulis demum recurvis violaceis basi flavidis; stigmatibus 10–14 stamina flavicantia superantibus; bacca ovata viridi irregulariter dehiscente; seminibus parvulis lenticularibus basi hilo oblongo truncatis verruculosis. (Tab. LIX. fig. 1–11.)

On the Rio Grande below Matamoras. Flowers in May and June. — Similar in habit to the last, but more slender. Branches ½ to 3 or 4 inches in length, 6–8 lines in diameter; tubercles 4–5 lines apart, in 4 rows [39] when the branches appear acutely quadrangular, or in 5 rows when they are more terete. Radial spines 1–2 lines long; central one on lower part of joint wanting, or hardly longer than the radial ones; on the upper part 2–4 lines long. Flower about 3 inches long and of same width; petals often reflexed, 4–6 lines wide. Fruit 6 or 8 lines long. Seed between 0.4 and 0.5 line long, much compressed, with a narrow hilum; its tubercles very much smaller than in the last species.

Our plant bears a close resemblance to the last-mentioned one, but may always easily be distinguished by the characters enumerated.

18. C. TUBEROSUS, Poselger: e radice tuberosa tenuissimus, teres, lignosus, sursum sensim incrassatus, cylindricus, demum articulatus parceque ramosus, debilis, erectus seu geniculatus et reclinatus; costis 8 vix prominulis; areolis parvis confertis, junioribus parce sordide tomentosis; aculeis 9–12 radiantibus parvulis subulatis albidis rectis adpressis, inferioribus paulo longioribus, centrali singulo e basi crassa subulato longiore toto seu versus apicem fusco sursum arrecto; floris subterminalis (?) tubo brevi; pulvillis squamatis albo-lanatis aculeolatis; sepalis superioribus 8 lineari-lanceolatis; petalis 16 oblanceolatis acuminato-aristatis roseis patentibus; filamentis brevibus; stylo elongato; stigmatibus 8 viridibus; bacca subsicca villosa setosaque floris rudimentisque coronata; seminibus minutis oblique obovatis compressis tuberculato-rugosis scrobiculatis. (Tab. LIX. fig. 12.)

On the Texan side of the Rio Grande, between Reynosa and Camargo (Dr. Poselger); on the Chacon hills, three miles below Laredo, and also near Mier, on arid rocky ridges, always among shrubs, "which support its weak and otherwise almost decumbent stem" (A. Schott). — Tuberous root globular, ¾–1½ inch in diameter. Stem 1–2 feet high; lower part ligneous, scarcely as thick as a quill; upper younger part and branches 4–8 lines in diameter; young branches few, clavate; ribs very little prominent; areolæ 1–2 lines apart. Radial spines a line long or less; central spine 2–3 lines long; in weak specimens whitish, in robust ones the upper half or the entire spine brown or black, rigidly erect and appressed, generally reaching to the second areola above. The flower — which I have not myself seen — is described by Dr. Poselger in a letter as being terminal, "so that the ovary is a complete continuation of the stem." I suppose that it rises from the upper, but certainly not the recent areolæ; and that it cannot be truly terminal, — i. e. a continuation of the axis, — which would be in opposition to the character of the whole family. Schott also figures the plant as bearing fruit at the end of the branches. Flower over 2 inches long and of the same diameter, opening for several days, but only in bright noonday sunshine; ovary and tube covered with very woolly pulvilli in the axils of reddish scales, with 6 or 8 long white or black bristles; petals rose-colored or purple, about an inch long. Fruit covered with long wool and black and white bristles, resembling very much that of *C. cæspitosus*.

Seed smaller than that of any other *Cereus* examined by me, — only 0.4 line in the largest diameter, — rugose from confluent tubercles, which leave large pits between them; albumen none; embryo almost straight, with distinct transverse cotyledons.

Flower, fruit, and seed identify this species with the *Echinocerei*, — thus furnishing another instance, if such were still needed, of the importance of the organs of fructification in the study and arrangement of the *Cactaceæ*, and of the fallacy of expecting the external shape of these plants to furnish characters for generic or subgeneric division. Without the knowledge of the flower and fruit, *C. tuberosus* would no doubt have been classed with the *Cerei articulati;* while in reality it is the slenderest *Echinocereus*, connected with the ordinary ovate or globose forms through *C. Berlandieri* and *C. procumbens.*

Subgen. 2. Eucereus.[5] [40]

19. C. Emoryi, E. in Sillim. Journ.: caule cylindrico 2–3-pedali prostrato; ramis adscendentibus seu erectis; costis 15 tuberculatis; sinubus acute incisis; areolis confertis orbiculatis, junioribus fusco-tomentosis; aculeis rectis rigidis gracilibus aciculatis e virescenti flavis numerosissimis intertextis, exterioribus 40–50 tenuissimis stellatim porrectis, centrali singulo robustiore multo longiore; floribus subterminalibus flavis; tubo breviusculo aculeolato; bacca globosa aculeatissima; seminibus magnis obovatis acute carinatis basi acutis lucidis minutissime sub lente tuberculatis, hilo ventrali angusto; cotyledonibus foliaceis hamatis incumbentibus. (Tab. LX. fig. 1–4.)

On dry hills and mountains, near the coast of California, about San Diego, growing in thick masses, and covering patches of 10 or 20 feet square (Dr. Parry); not north of the boundary line (Dr. Le Conte). — Prostrate stems 2–3 feet long; branches 6–9 inches high, $1\frac{1}{2}$ inch in diameter; flowers abundant near the top of the branches, rather short, yellow, 2 or $2\frac{1}{2}$ inches wide. Fruit $1\frac{1}{2}$ inch in diameter, densely covered with numerous pulvilli, each bearing 20 or 25 stiff yellow spines, from 2 to 6 lines in length, 3 of them stouter and longer than the rest, often about an inch in length; some indistinct remains of the dead flower are hidden among the spines. Seed 1.2–1.4 line long, with a very prominent keel and linear hilum. The short aculeolate flower, persistent on the spinose fruit, would seem to refer our plant to *Echinocereus*, but the seed and embryo permit no doubt about its position. I have seen specimens of a fruit of a columnar *Cereus* from the Pacific coast near Mazatlan, sent by the late Dr. J. Gregg, which is a gigantic representative of our California fruit, and suggests the idea that on the western coast of our continent several species exist of a still unknown section of *Cereus.*

This plant, peculiar to the western termination of our boundary line, fitly bears the name of the energetic and distinguished commissioner under whose auspices the greater part of the interesting plants here described have been collected.

20. C. variabilis, Pfeiff., a tall species, 3–10 feet high, common to the east as well as west coast of tropical America, extending northward to the mouth of the Rio Grande, and up that stream toward Matamoras. — Full-grown stems 3–4 angled, with few and stout spines, but young shoots with 8 ribs and numerous slender spines. Flowers white, nocturnal; fruit oval, about 3 inches long, spinose, crimson externally and internally. Seeds obliquely obovate, compressed, nearly smooth, and shining, 1.5–1.7 line long; hilum subventral, narrowly oblong or linear, albumen almost none; embryo much curved; cotyledons large, foliaceous, incumbent. (Tab. LX. fig. 5–6.)

21. C. Greggii, E. in Wisliz. Rep.: e radice crassa napiformi erectus, gracilis, 2–3-pedalis; ramis paucis erectis 3–6 angulatis atro-virentibus sæpe rufescentibus; costis acutis; sulcis latis planiusculis; areolis oblongo-linearibus confertis seu subconfertis, junioribus lana e cinereo nigricante demum decidua vestitis; aculeis e basi [41] bulbosa crassa abrupte subulatis acutissimis brevissimis nigricantibus, vetustis cinereis, radialibus 6–9 subrecurvis, infimis 3 tenuioribus longioribus, centralibus binis superimpositis brevibus, rarius singulo; floribus lateralibus albidis seu ochroleucis (nocturnis?); ovarii ovati pulvillis orbiculatis obscuro-villosis vix aculeolatis; tubi elongati sepalis 40–60 squamiformibus lineari-lanceolatis acuminatis, inferioribus aculeolos paucos breves, superioribus plures capillares gerentibus; sepalis interioribus 15–20 et petalis totidem lanceolatis acuminatis; stylo stamina æquante; stigmatibus sub-10 erecto-patulis albidis; bacca ovata basi contracta apice rostrata floris rudimentis siccis recurvis demum deciduis coronata pulvillis aculeoligeris mox nudatis munita coccinea pulposa; seminibus magnis oblique obovatis rugosis tenuissime tuberculatis; hilo subbasilari circulari; albumine parcissimo; embryone cotyledonibus foliaceis incumbentibus hamato.

[5] This section is proposed here only as a receptacle for our few *Cerei* not included in the other subgenera. It is not impossible that the greater part of the species of this genus will have to be referred here; but it is more probable that a careful examination of the flower and fruit of the numerous southern *Cerei* will necessitate the formation of several other subgenera. Not being familiar with the great majority of the species, I refrain from characterizing *Eucereus.* I will only state that the few species referred here have an elongated stem; spines on the flower-bearing and sterile part of the plant not different; tube of the flower elongated, and beset with hairy or spiny pulvilli; stigmata whitish; berries usually with deciduous (or persistent?) spines; dry remains of the flower usually at length deciduous; seeds mostly smooth and shining, and the embryo hooked, with curved foliaceous cotyledons.

Var. *α*. CISMONTANUS: areolis elongatis; floris tubo minus gracili aculeolis brevioribus munito; petalis latioribus. (Tab. LXIII. LXIV.)

Var. *β*. TRANSMONTANUS: areolis ovato-orbiculatis; floris tubo graciliori aculeolis longioribus tenuiter capillaceis flexuosis munito; petalis lineari-lanceolatis longe acuminatis. (Tab. LXV.)

From the San Pedro in western Texas (Parry, Wright, Bigelow), to the Gila (Emory) and Sonora (Thurber, Schott); and from the Rio Grande south to Chihuahua (Gregg, Wislizenus); in gravelly or hard clayey soil; nowhere a common plant. Flowers in May and June. — Root a large fleshy, dirty-yellowish tuber, often 4–6 inches in diameter and 6–10 inches long, generally producing but 1 stem, 2–3 feet high, with erect branches; stem thin at base, rather terete and ligneous, upward 9–12 lines in diameter, usually 4–5, angled. The acute ribs at first sight seem crenulated, the pulvinate areolæ being separated by a slight depression, and the spines being scarcely visible without a close examination. Areolæ 1–1½ line long; in younger shoots 5–6 within 1 inch of the rib; in older plants about 3 areolæ in the same space. Spines remarkably short and sharp from a disproportionately thick base, only ½–1 line long: the 3 lowest spines are the longest, and run into a fine bristle-like point, often somewhat curved, and not rarely crossing each other; above them 2 or usually 3 pairs of lateral spines, points of the lower ones diverging downward, and of the upper ones rather upward; central spines mostly 2, very short and thick, the lower one turned downward, the upper one upward. The spines seem to grow in size for several years, as on the older part of the stem they are twice as thick though not any longer than the younger ones; they also become irregular, some of the smaller apparently dropping out, while the larger ones crowd into the vacant space (see figure). The flowers have been seen by only Dr. Gregg and Mr. Thurber; they seem to be nocturnal, as the latter gentleman collected them in the early morning hours, commencing to fade. Ovary 9–12 lines long, whole flower 6–8 inches long, about 2½ inches in diameter; bristles at base of tube 1–2 lines, or upward 4–6 lines, and in var. *β*. 6–10 lines long; style not reaching above the large anthers; stigmata about 10, suberect. Berry ovate, 1¼–1½ inch long, an inch in diameter, slightly contracted at base, but not stiped nor even clavate, — as I formerly was induced to believe, — somewhat rostrate at the upper end, bright scarlet, fleshy, and edible. Seeds 1.2–1.5 line long, 1 line thick, with a large hilum; the warts of the testa are flat and very minute, but the large wrinkles are very distinct to the naked eye. The young seedling has quite short cotyledons, which finally form a thickened rim around the base of the young stem; this stem is always triangular, of a reddish-brown color, the edges showing an almost continuous line of the characteristic small and sharp spines; the root very soon swells, as our figure shows, and assumes the shape of a small carrot, almost as large as the [12] stem itself; in old specimens the root is very much larger than the whole stem and branches together.

Subgen. 3. LEPIDOCEREUS.[6]

22. C. GIGANTEUS, E. in Emory's Rep. 1848: erectus, elatus, cylindricus, versus basin apicemque sensim attenuatus, simplex seu parce ramosus, candelabriformis; ramis paucis erectis caule brevioribus; vertice applanato tomentoso; costis infra sub-13 sursum 18–21 rectis, vetustis (versus caulis basin) obtusis obtusissimisque, sursum e basi lata acutatis acie obtusatis subrepandis; sinubus ad basin caulis latissimis versus apicem profundis acutis angustioribus angustissimisque; areolis prominentibus ovato-orbiculatis, junioribus albido-tomentosis; aculeis rectis basi valde bulbosis tenuiter sulcatis et subangulatis albidis seu stramineis demum cinereis; radialibus 12–16, imo summisque brevioribus, lateralibus (præcipue inferioribus) longioribus robustioribus, subinde aculeis adventitiis paucis setaceis summo areolæ margini adjectis; aculeis centralibus 6 robustis albidis basi nigris apice rubellis demum totis cinereis, 4 inferioribus cruciatis quorum infimus longissimus validissimus deflexus, 2 superioribus brevioribus, lateralibus sursum divergentibus; floribus versus apicem caulis ramorumque aggregatis; ovarii ovati sepalis 30–40 squamiformibus triangulatis acutis ad axillam albido- seu fulvo-villosam aculeolum unum alterumve nigricantem deciduum gerentibus; sepalis tubi ampliati breviusculi 30–40 orbiculato-subdeltoideis mucronatis, inferioribus in axilla lanigeris, superioribus nudis; sepalis intimis 10–15 spathulatis obtusis carnosis (pallide viridibus albescentibus); petalis sub-25 obovato-spathulatis obtusis integris crispatis coriaceo-carnosis crassis (ochroleucis seu albidis); staminibus numerosissimis superiori tubi parti adnatis, inferiore nudo; stylo stamina paulo superante; stigmatibus 14–18 filiformibus fasciculatis; bacca obovata seu sæpe pyriformi squamis triangulatis carnosis parvis ad axillam lanatis munita, floris rudimentis deciduis; pericarpio duriusculo coriaceo demum valvis 3–4 irregularibus patulis reflexisve dehiscente; seminibus numerosissimis in pulpa saccharina coccinea nidulantibus oblique obovatis lævibus lucidis exalbuminosis; hilo oblongo basilari; cotyledonibus foliaceis incumbentibus hamatis. (Tab. LXI. LXII. et tab. front.)

[6] This subgenus is proposed for the two tall western species with uniform spines, short flowers, ovary and tube with numerous scale-like imbricated sepals, fleshy petals, pale stigmata, smooth seeds, and hooked embryo. Probably *C. Chilensis*, and perhaps other species from the Pacific slope of the continent, will find their place here. A drawing of *C. Chilensis*, among the papers of the United States Exploring Expedition, represents a flower almost identical with that of *C. Thurberi*.

In rocky valleys and on mountain sides, often in mere crevices of rocks, from the valley of Williams's River, lat. 35° (Bigelow), to Sonora, lat. 30° (Thurber, Schott); and from the middle Gila (Emory) down to near its mouth (Parry). I cannot find that it has been collected west of the Colorado, though it is probably also an inhabitant of the California peninsula. Flowers from May to July; fruit ripe in July and August. The *Suwarrow* or *Saguaro* of the natives. — Young plants, as Dr. Bigelow observed, are almost always found under the protecting shade of some shrub, especially of Frémont's "green-barked Acacia" (*Cercidium Floridanum*), so characteristic of the barren wilderness; and not rarely the dead stems of this plant are found near the older *Cerei*. Young plants retain their globose shape for several years; a specimen in my possession, 5 or 6 inches high, is supposed to be between eight and ten years old. It flowers at the height of 10 or 12 feet, but grows up to four or five times that height. Stems have been measured 46 feet high, and higher ones are stated to occur; so that the first statement of Colonel Emory is not at all improbable, — namely, that this plant sometimes has been found 50–60 feet high. The stem is thickest in or a little above the middle, and tapers upward and downward; one was found by Dr. Bigelow to be at 1 foot [43] above the ground 13 inches, and 10 feet higher more than 23 inches, in diameter. The fleshy part of the plant is, as he notes, bitter, and not acidulous, as in most species of Cacti. The ligneous skeleton consists of thick (1–2 inches thick) and somewhat terete perpendicular bundles of fibres, corresponding in number and position to the grooves of the stem. In younger plants and on the upper part of the older ones these sticks are distinct, and sway in the wind like so many reeds, but at the lower part of the older stems they are reticulately connected with one another by ligneous tissue, the open meshes corresponding (just as in the cylindric *Opuntiæ*) with the bunches of spines or tubercles; in the oldest stems the inner cavity becomes nearly filled by the same tissue. Stems mostly simple, older ones often with a few erect branches; they are rarely much branched, but specimens have been observed where 5–9 branches sprang from the same part of the main stem; the primary branches very rarely produce secondary ones; the branches usually drop off from the skeleton of the dead stems, but in very old specimens they remain, and present a view like the one in our landscape plate opposite the titlepage, which is taken from an accurate sketch made on the spot by Mr. Mœllhausen. Ribs at the base of the stem few (12–15), broad, obtuse, often almost obliterated, and generally without spines; higher up the number of ribs increases to about 18–21; they are triangular with an obtusish edge, separated by deep triangular acute grooves; toward the top of the plant the young ribs are narrowly compressed, with obtusish edges and narrow grooves between them. The somewhat pulvinate areolæ are 7 lines long, nearly 6 lines in diameter, about an inch distant from one another, sometimes more closely approximate; at first they are covered with a thick yellowish or tawny tomentum. Lower and upper radial spines 6–12 lines long, sometimes a few additional shorter flexuous setaceous spines are placed above; lateral ones 12–18 lines long, the lower ones longest; the 4 lower central spines straight, or very slightly curved downward 20–30 lines, the 2 upper central spines 15–18 lines long, diverging upward. The stoutest spines are 1 line in diameter, their bulbous base fully twice as thick. In old age, and toward the base of the stem, the 6 central spines fall off first, leaving the radiating ones appressed to the stem; finally these also come off, together with the whole areola. The flowers are produced in abundance near the summit of the stems and branches; the fruit is usually found 6–12 inches from the centre of the top. Specimens of flowers have been sent by Mr. Thurber and by Mr. Schott: those of the former are not over 3 inches long, the others have a longer tube, and are between 4 and 5 inches in length and 3–4 inches in diameter; the flowers are probably open day and night. Ovary 1–1⅓ inch long; lower scales of the tube triangular; upper sepals fleshy, greenish-white, ¾–1 inch long, lower ones 2, upper ones 3–4 lines wide; petals of a light cream color, 1–1½ inch long, 6–8 lines wide above, very thick and fleshy, and very much curled; filaments light yellow, adnate to the upper half of the tube, its lower part for the length of 1 or 1½ inch naked; stigmata over half an inch long, slender, suberect, of a greenish-yellow color. Fruit 2½–3 inches long, 1½–2 inches in diameter, oval or obovate, or often narrowed at base and almost pear-shaped (perhaps where many are crowded together); the remains of the flower falling off leave a broad convex scar; the color of the fruit is green, and towards the upper end reddish. The pericarp has the hardness of a green cucumber, somewhat softer towards the apex, and is about 2 lines thick; it bursts open on the plant with 3 or usually 4 valves, which are red on the inside, and when spreading horizontally, or somewhat recurved, look like a red flower. The crimson-colored sweet but rather insipid pulp has the consistency of a fresh fig; it completely separates from the rind, and, drying up from the heat of the sun, falls to the ground. [44] The innumerable black seeds are 0.7–0.9 line long. Those brought by Mr. Thurber, and largely distributed in this country and in Europe, have well germinated; the cotyledons are short and acute; the seedling plant is globose, grows very slowly, and is rather delicate.

23. C. THURBERI, E. in Sillim. Journ.: caulibus erectis seu adscentibus elatioribus fasciculatis articulatis 13–14-costatis; sinubus planiusculis; areolis subremotis pulvinatis griseo- seu fulvo-tomentosis; aculeis 7–15 gracilibus rectis flexuosisve fusco-atris demum cinereis valde inæqualibus irregulariter fasciculatis; floribus infra caulis apicem lateralibus aggregatis; ovarii squamis sepaloideis 80–100 pluribusve triangularibus imbricatis axilla lanam copiosam albidam vel fulvam sæpeque aculeolos paucos nigricantes gerentibus; sepalis tubi sub-50 olivaceis, inferioribus acutiusculis, superioribus obovato-spathulatis obtusis; petalis obtusis carnosis albidis; bacca magna globosa

aculeolata demum nuda olivacea intus coccinea ; seminibus numerosissimis oblique obovatis dorso carinatis læviusculis (sub lente minutissime tuberculatis) lucidis exalbuminosis ; hilo oblongo subbasilari, embryone cotyledonibus foliaceis curvatis incumbentibus breviter hamato. (Tab. LXXIV. fig. 15.)

In a rocky cañon near the mountain pass of Bacuachi, Sonora (Thurber) ; on all the sierras of Sonora westward of the Sierra Madre, and more common southward (Schott), — called there *Pitahaya*. Flowers in June and July ; fruit in July and August. — Stems 5–15 from one root, fasciculated, erect or ascending, "curved *inward*," 10–15 feet high, articulated ; lower joints 2–3, upper ones 5–6 feet long, 4–6 inches in diameter ; ribs 13–14, very slightly prominent. The skeleton of this species, according to Mr. Schott's observations, consists of flattened bundles of wood, very loosely connected by transverse fibres, so as to form a kind of hollow tube. Areolæ pulvinate covered with brownish, or ashy wool, only about 3 lines in diameter, 12–15 lines apart. Spines irregularly fasciculated, 7–10 according to Mr. Schott's notes, but 15 in the flower-bearing bunches before me. (Might not the flower-bearing spines be more numerous and perhaps more slender than the others, indicating a transition to *Pilocereus ?*) Spines slender, flexible, almost setaceous, very unequal in length, 5–18 lines long in the same bunch, partly deciduous. Flowers usually 6–12 inches below the top of the plant, about 3 inches in length ; ovary very densely imbricate with sepaloid scales, which bear dirty wool and often short bristly spines in their axils ; in some specimens they are wanting, in others they also invest the fruit, but are easily brushed off at maturity. Fruit 3 inches in diameter, like a large orange, of delicious taste, the crimson pulp dotted with numerous black seeds ; these are 0.9–1.0 line long only, — a little larger than those of the last species, which they very much resemble, — and very minutely tuberculated. The seeds germinate like those of *C. giganteus*, with very short acute cotyledons, and grow up with a globose head like the *Echinocerei*, while all the *Eucerei* which I have seen germinating at once grow up in a cylindric or prismatic column.

Subgen. 4. Pilocereus.[7]

24. C. Schottii, sp. nov. : caulibus suberectis elatioribus fasciculatis articulatis 4–7- (plerumque 5-) costatis flavo-viridibus ; areolis in caulibus sterilibus remotis aculeos radiales 4–6 robustos breves cinereos [45] obscuros singulumque centralem breviorem obscuriorem gerentibus, in caule superiore florifero confertis lanam cinerascentem aculeosque 15–25 setiformes elongatos flexuosos angulosos rubello cinereos declinatos et quasi pendulos ferentibus ; floribus in aculeorum barba pene occultis carneis ; tubo gracili supra ovarium globosum 10-squamatum constricto decurvo intus basi nudo sepalis 10–12 lanceolatis instructo ; petalis 10–12 oblongis obtusiusculis ; stigmatibus 5–6 fasciculatis ; bacca parva globosa squamosa pulposa coccinea floris rudimentis coronata ; seminibus oblique obovatis carinatis lævissimis lucidis, hilo angusto subventrali ; albumine parcissimo ; embryone hamato cotyledonibus curvatis foliaceis incumbentibus seu subinde obliquis. (Tab. LXXIV. fig. 16.)

Sierra di Sonoyita, and southeast toward Santa Magdalena, Sonora, where it is named *Zina*, or *Sina*, or *Sinita* by the inhabitants (Schott). In August with flower and ripe fruit. — Stems 8–10 or more from the same base ; 8–10 feet high, ascending at base, and when full grown always curved outward at the top, the reverse of *C. Thurberi*. Often many plants together, forming thickets, and covering a large space of ground ; not rarely associated with the just-mentioned species. Stems of 2–4 articulations of 4 or 5 inches diameter ; lower part entirely denudated of the quite deciduous spines. Spines of the sterile joints, or young plants, 5–7, not over 3 or 4 lines long ; areolæ of the flowering joints 3 lines in diameter, covered with a dirty-whitish tomentum, 2–3 lines apart ; spines irregularly fasciculated, 10–25 in number, and from 1 to 4 inches long, flexuous and pendulous. Flower somewhat hidden in this reddish-gray beard, and its tube evidently bent downward by it ; length of flower $1\frac{1}{2}$–$1\frac{3}{4}$ inch ; sepals without any wool in the axils, olivaceous, lower ones triangular, acute, upper ones lanceolate ; petals dirty flesh-color ; stamina comparatively few, leaving the top of the ovary and the lower part of the tube naked ; stigmata 5–6, filiform, broom-shaped, exactly like those of *C. giganteus* or *C. Thurberi*. Berry scarlet, 3 or 4 lines in diameter. Seeds very similar to those of *C. giganteus*, but larger, 1.0–1.2 line long ; germination very much like that of the last two species ; cotyledons of seedling plant acute, short, spreading ; head globose, but soon somewhat elongated, while both others remain globose for a long time.

C. Schottii is closely allied to *Pilocereus scoparius*, Poselg., from Vera Cruz. This, however, is a larger plant, 20–25 feet high, 1 foot in diameter, with 12–15 ribs on the sterile, and 20–25 on the flowering part. I have named this interesting species, the only *Pilocereus* of our Flora, after its zealous discoverer, whom I have often had occasion to mention in these pages, and who, with all his other arduous duties in the field, still found leisure and inclination to study the Botany of the Boundary from the Pacific to the Gulf of Mexico.

[7] *Cereus Schottii*, described in the text (evidently a *Pilocereus*, as that genus has been established by Lemaire), leaves no doubt in my mind about the propriety and necessity of a reunion of the "Old man Cactus" and its allies with *Cereus*. As a subgenus, *Pilocereus* would be characterized by the difference of the sterile and the flower-bearing parts of the plant (the latter having more numerous, longer, and thinner, often hair-like spines), and by the smaller flowers with all the parts reduced in number. The other characters ascribed to *Pilocereus* (filaments from the whole surface of the tube, and even from the top of the ovary, and especially the short and globose cotyledons) are not found in our species.

IV. OPUNTIA, Tourn., Mill.[8]

Subgen. 1. Stenopuntia.

Articuli complanati. Aculei non vaginati.
Flores parvi. Petala parva, subulata, erectiuscula (aurantiaca).
Stigmata pauca (1–3), acuta.
Bacca? et Semina?

The habit of the two species — the only ones yet known — is entirely that of the next subgenus; but the [46] small flower (less than 1 inch in diameter) has numerous very small and narrow petals, and few and acute stigmata. *O. grandis*, the only other species known, has 2 or 3 stigmata, and *O. stenopetala* only one stigma. I must remark here that all the ovaria I have opened contained no ovules, and not even a cavity. May not the acute single style (an unique and anomalous case in this family) be in some connection with this sterility, and may these flowers not be abortive or staminate forms?

1. O. stenopetala, sp. nov.: prostrata; articulis magnis crassis; pulvillis ad marginem confertissimis fusco-setulosis; aculeis sub-3 compressis ancipitibus curvato-deflexis seu patulis, adjectis sæpe 1–3 minoribus, omnibus atrofuscis; floribus ex areolis fulvo-villosis; ovarii obconici tuberculati pulvillis 30–40 confertis albido-tomentosis setosis; sepalis tubi petalisque sub-25 lineari-subulatis acuminatis aristatis aurantiacis erecto-patulis; imo tubo nudo; stylo medio globoso-ventricoso apice indiviso acuto staminibus sub-breviore. (Tab. LXVI.)

Common on the battle-field of Buena Vista, south of Saltillo, Mexico (Dr. J. Gregg, 1848). Flowers in July. — The specimens before me consist of dried segments of joints, bearing flowers. Joints apparently large, perhaps 7 or 8 inches in diameter; pulvilli about 1¼ or 1½ inch apart on the surface, but much crowded toward the edges, with much dirty-white wool, short dark brown bristles, and very dark, almost black spines, lighter at the tip. The stouter spines 1½–2 inches long, flat on the upper, rounded on the lower surface, often much curved. Floriferous pulvilli very woolly; ovary about 9 lines long; leaves (or sepals) on the tubercles deciduous, very slender, 2–2½ lines long, sepals and petals 4–6 lines long, not more than 1 line broad at base, very slenderly acuminate, fleshy; sepals greenish-red, petals orange. Stamens numerous, half as long as the petals; style very much inflated in the middle, and to all appearances (I have carefully examined about six flowers) with a single pointed stigma. No fruit or seed was obtained; nor is it probable that these flowers would have ripened fruit, as no ovula could be found. Cannot this curious plant be obtained living? It is interesting to find in the Mexican *O grandis*, mentioned above (which has long been cultivated in European gardens, but has only lately for the first time flowered in Prince Salm's collection), a very similar species, confirming this subgenus: this is an erect plant, with smaller joints, two white spines on the pulvilli, and 2 or 3 acute stigmata.

[8] Besides its strictly differential characters (namely, the rotate corolla and the flat bony seeds with large foliaceous cotyledons), this genus is distinguished from the other Cactaceæ by its subterete, subulate, and deciduous leaves, and by its barbed spines, which I do not find in any other plant of this family. These spines render *Opuntiæ* so much more disagreeable and even dangerous than other *Cacti*. In several species (*O. fragilis*, *O. Bigelovii*, *O. frutescens*, and others) the joints easily separate from the stem, and adhere by their barbed spines to the skin or clothes of the passer-by, — the most annoying burs. Besides these spines, — which are usually, although not in every species, present, — bristles are almost invariably found on each pulvillus, usually small (less than 1 or 2 lines long, sometimes longer), and very numerous, mixed with soft wool. These bristles are extremely sharp, and barbed backward like the spines, and are loosely attached at their insertion; consequently when touched they come off from the plant and adhere most annoyingly to the skin or clothing. Both the *areola aculeifera* and the *areola florifera* are united in this genus into one circular or oblong *pulvillus* in the axil of the deciduous leaf. The spines occupy the lower and the bristles the upper part of this *pulvillus*; between the bristles, and surrounded by them, and always above the spines, the young shoots or flowers originate. These bristles correspond with the bristles and wool in the axils of some *Eumamillariæ*, and with the tomentum of the floriferous areola in *Coryphantha* and *Echinocactus*, but are quite distinct, morphologically, from the spines themselves. In *Eumamillariæ* the aculeiferous and floriferous areolæ are entirely separate; in *Coryphantha* they are united by a long groove; in *Echinocactus* by a short one, or are quite contiguous, although always distinct; in *Cereus* we do not observe a persistent floriferous areola, — the flower, as well as the young bud, bursts the epidermis above and close to the spiniferous areola, where a kind of floriferous areola is formed, and continues till soon after the fall of the fruit, when it gradually disappears. In all these plants the floriferous areola occurs only on the fully developed part of the plant capable of bearing flowers. But in *Opuntiæ* the pulvillus (which in its lower part is the spiniferous and in its upper part the floriferous areola combined) is the same in all stages of development; only it is smaller on the lower part of each joint, and bears fewer or often no spines, and rarely if any flowers or new shoots, while the uppermost *pulvilli* have the longest and most numerous spines, and bear the flowers as well as the young branches. The *pulvilli* of *Opuntiæ* continue to grow year after year, and the bristles become longer and more numerous, and in many species the spines themselves grow stouter. Sometimes new spines are developed between the bristles, indicating a low degree of continued vegetative activity on the rudimentary axis represented by the floriferous areola.

Subgen. 2. PLATOPUNTIA. [47]

Articuli complanati, lanceolati, elliptici, obovati seu suborbiculati. Aculei nunquam vaginati.

Flores majores seu magni. Petala latiora, obovata seu orbiculata, flava seu rarius miniata, rarissime purpurascentia.

Stigmata plura (5–10) obtusa.

Bacca floris rudimentis dejectis late umbilicata, pulposa seu succosa, et inermis, rarius sicca et aculeata.

Semina margine latiore seu angustiore cincta.

Embryo plus quam circularis circa albumen parcum spiraliter convolutus. Cotyledones semper contrariæ, incumbentes.

This is the well-known form of *Opuntiæ*, with compressed and more or less elliptic joints, decumbent or erect, with fibrous or sometimes tuberous roots; mostly with spines only on the upper or in one section (*Xerocarpeæ*) on all the pulvilli, rarely (principally the *Pubescentes*) spineless. Flowers commonly 2–3 inches and sometimes even 4 or 5 inches in diameter; stigmata, as far as my observation goes, always from 5 to 8 or at most 10 in number, whitish, yellowish, or green, patulous or mostly erect. Fruits often edible, so that some species are cultivated for their fruits, and have been introduced into the warmer parts of the other continents; in the section *Xerocarpeæ* the fruits are spiny and dry. Seeds among the largest in the whole genus, or even in the whole family; in some species over 3 lines in diameter.

2. O. STRIGIL, sp. nov.: suberecta; articulis ovatis obovatis seu orbiculatis obtusis seu subinde subacutis tenuibus; pulvillis confertis, junioribus albido-villosis mox setis difformibus stramineis stipatis, omnibus aculeiferis; aculeis rufis fuscisque versus apicem flavidis, 5–8 radiantibus deflexis, versus margines articuli cum 1–2 robustioribus longioribus erectis patulis seu deflexis; bacca parva subglobosa late umbilicata areolis 25–30 minutis stipata rubra; seminibus parvis crassis obtuse marginatis. (Tab. LXVII.)

Western Texas, west of the Pecos, in crevices of flat limestone rocks; Wright, Bigelow. — About 2 feet high, pale green; joints covered with numerous pulvilli, each with a bunch of bright red-brown spines, paler at the tip, which give this plant a very showy appearance. Joints 4–5 inches long, 3½–4 inches wide; pulvilli 4–6 lines apart, prominent; their whitish wool soon disappears, leaving them covered with fine pale-yellow bristles, a dozen of which are longer than the rest, radiating upward and laterally, and by joining the lower radiating spines forming with them a complete circle. Spines on most areolæ 5–8, — on the lower ones (as usual) fewer, shorter, and paler, on the upper and marginal ones more perfect; exterior radiating spines 3–4 lines, lower ones 5–8 lines long; the one or two stouter somewhat compressed spines on the upper areolæ are nearly an inch long, deep-brown below, light red-brown in the middle, gradually fading into yellow at the point. Flower unknown. Fruit 6-7 lines long, about 6 lines thick, with a broad and flat umbilicus; areolæ small, with gray wool and a few bristles. Seed 1½ line in diameter, rather irregular, very thick in proportion.

It would be desirable to obtain living specimens of this showy species, which could be easily done by travellers on the now well-frequented road between San Antonio and El Paso.

3. O. ENGELMANNI, Salm: erecta, grandis; caule demum lignoso tereti cortice cinereo rimoso obducto; articulis orbiculato-obovatis seu obovatis magnis pallide viridibus; pulvillis remotis griseo-tomentosis; setis [48] flavis rigidis valde inæqualibus sparsis; aculeis paucis (in areolis superioribus plerumque 2–3) validis compressis seu angulatis rectis seu subinde curvatis deflexis seu varie divergentibus stramineis corneisve basi rufis, cum adventitiis inferioribus 1–2 gracilioribus pallidioribus sæpe deficientibus; floribus flavis intus rubellis; ovario obovato-subgloboso seu rarius elongato subclavato sepalis e basi lata subulatis et pulvillis 20–25 griseo- seu fulvo-tomentosis parce setosis instructo; sepalis tubi sub-13, exterioribus ovato-lanceolatis acuminatis, interioribus orbiculato-obovatis cuspidatis; petalis 8–10 obovatis subspathulatis obtusis mucronatis; stylo crasso parum tumido; stigmatibus 8–10 erectis; bacca globoso-obovato seu rarius pyriformi late umbilicata; seminibus minoribus sub-irregularibus plerumque anguste marginatis. (Tab. LXXV. fig. 1–4.)

From the Canadian River (Bigelow) to New Braunfels, in Texas (Lindheimer), and to the mouth of the Rio Grande; westward to the Pecos and Presidio (Bigelow), El Paso (Wright), and perhaps to the Pacific (Parry); south to Chihuahua (Wislizenus). Flowers in May and June. — A stout, coarse-looking plant, 4–6 feet high; lower part of old stems woody with loosely reticulated ligneous fibres, and with gray bark often covered with lichens, about 6 inches in diameter. Joints in the larger specimens 1 foot long, 9 inches in diameter; leaves subulate, 3–4 lines long, patulous; pulvilli 1¼–1½ inch apart, 3–4 lines in diameter; bristles coarse, sparse, and very unequal, longer ones on the upper edge of the pulvillus sometimes 4–6 lines long; spines 1–1½ inch long, lower smaller ones 6–9 lines long. Flower 2½–3 inches in diameter, characterized by the usually quite short ovary and the comparatively narrow and not emarginate petals. Ovary commonly 1–1¼ inch long, almost globose; in some instances, however, I have seen it clavate and nearly 2 inches long (perhaps then sterile and inclined to become proliferous). Fruit subglobose, some-

what contracted at base, nearly 2 inches long; umbilicus about an inch in diameter, flat or a little depressed; fruit dirty purplish, usually with a bright purplish pulp, of an insipid or even nauseous taste. Seeds usually less than 2 lines, in most specimens only 1.5–1 7 line in diameter, of a regular (from Matamoras) or commonly more irregular twisted shape, with an obtuse or acutish, rather narrow margin. Young plants raised from seed are characterized by the fascicles of very long (¾–1 inch) fine woolly hairs on the pulvilli, which appear in the second season, and remain for several years. Among the numerous varieties of this species, the var. *cyclodes*, from the upper Pecos, has been described in Captain Whipple's Pacific Railroad Report; another one was collected by Mr. Wright on the Limpia, with 1–6 stout, curved spines on the upper pulvilli, and none at all on the lower ones.

Dr. Bigelow distinguishes from this species another plant, which he has frequently observed near Presidio del Norte and Eagle Pass. From his notes, and from the meagre material on hand, I venture to describe it, without asserting its specific difference from the last species.

O. DULCIS, sp. nov.: adscendens, patula; articulis obovatis; pulvillis remotis; setis fulvis difformibus, exterioribus confertis tenuioribus brevioribus subæqualibus, interioribus uniseriatis robustioribus multo longioribus; aculeis 2–3 angulatis sæpius tortis pallidis deflexis, sæpe cum 1–3 gracilioribus; bacca ovata late umbilicata pallida; seminibus minoribus regularibus anguste marginatis. (Tab. LXXV. fig. 5–7.)

A suberect, spreading bush, lower and with smaller joints than the last species, and always with a very sweet and pleasant-tasted fruit. Plant about 2 feet high; joints ½ foot long; spines 1–1¾ inch in length, almost white. A semicircle of short spines or long bristles distinctly separates the spiniferous from the bristly part of the pulvillus; the bristles themselves are much more numerous, finer, and more crowded than in *O. Engelmanni*. [49] This arrangement of the bristles I find again only in *O. chlorotica* (Engelmann & Bigelow), from the western Colorado. The spines resemble *O. tortispina* (Engelmann & Bigelow); the flower and fruit, *O. Engelmanni;* and the seed seems different from all these Fruit 1½–1¾ inch long, 1 inch in diameter; umbilicus ¾ inch wide, shallow. Seeds 1.5–2.0 lines in diameter.

O. OCCIDENTALIS, E. & B. in Pac. Rail. Rep., found by Dr. Bigelow "in immense patches forty miles east of Los Angeles," California, was also observed by Mr. Schott in the high valleys of San Pascual and Santa Isabel, northeast of San Diego, "covering extensive tracts of land." It is probably a good species, and quite distinct from *O. Engelmanni*. Young plants raised from Dr. Bigelow's seeds do not show the peculiar capillary spines of that species mentioned above.

Another *Opuntia* grows on the hill-sides and plains near San Diego (Parry), and on the sea-beach there (Schott). An erect plant, 4–6 feet high; spines 2–4, stout, compressed, yellowish or brownish, also forming large thickets; joints 6–8 inches long and 4–6 inches wide; ovary subglobose, with 16–20 bristly pulvilli; 15–18 broadly obovate cuspidate sepals; about 8 (?) orbiculate petals; 8–10 stigmata; a large yellowish or purple fruit, of pleasant taste, much relished by the inhabitants Whether this is a form of *O. Engelmanni*, or *O. Ficus Indica*, — which, from having for a long while been cultivated about the settlements, may have become naturalized, — I cannot at present determine.

4. O. MACROCENTRA, sp. nov.: adscendens; articulis magnis suborbiculatis tenuibus sæpe purpurascentibus; foliis gracilibus lineari-subulatis; pulvillis subremotis orbiculato-ovatis setas graciles breves fulvas tomentum griseum vix superantes gerentibus plerisque inermibus, summis et marginalibus solum armatis; aculeis 1–2 rarius pluribus prælongis rectis seu varie flexuosis fusco-atris sursum pallidioribus sæpe annulato-notatis, superiore terete inferiore subbreviore compresso seu canaliculato; flore flavo; ovario ovato; pulvillis 20–25 villosis et fulvo-setosis versus superiorem ovarii partem congestis; sepalis tubi 13 lanceolatis seu interioribus obovatis acuminatis cuspidatisve; petalis sub-8 obovatis obtusis mucronatis; stigmatibus 8; seminibus majusculis late obtuseque undulato-marginatis. (Tab. LXXV. fig. 8.)

Sandy ridges in the bottom of the Rio Grande near El Paso, also on the Limpia (Wright). Flowers in May. — A remarkably striking plant, 2–3 feet high, with large, almost rounded, thinly compressed, often purplish joints, and very long nearly black spines, of which it would be very desirable to obtain living plants, as none of those sent home by Mr. Wright have survived. Joints 5–8 inches long, 4–7 inches wide; leaves 2½–3 lines long, remarkably slender; pulvilli ¾–1 inch apart, lower ones smaller and closer together, unarmed; spines on the upper ones 2–3 inches long, lower half almost black; ovary 1¼ inch long, 8 lines in diameter; flower 3 inches in diameter when fully open. The seeds sent by Mr. Wright as belonging to this species are 2.0–2.2 lines in diameter, much twisted, their border undulating, very similar to seeds of some form of *O. phæacantha*. From this species our plant seems to be distinguished by its larger, thinner, more orbicular joints, the closer and more woolly pulvilli, the slenderer leaves, and the small number of very long spines; the ovary also is more elongated, the sepals narrower, the flower larger.

5. O. PHÆACANTHA, E. in Plant. Fendl.: diffusa, adscendens; articulis obovatis seu suborbiculatis crassis glaucescentibus; foliis e basi crassa subulatis; pulvillis subremotis orbiculato-ovatis setas graciles stramineas seu fuscatas tomento griseo plerumque longiores gerentibus plerisque armatis; aculeis 2–5 rectis superiore [50] teretiusculo porrecto, cæteris brevioribus inæqualibus plus minus angulatis seu compressis deflexis fuscis seu

fusco-atris sursum pallidioribus ; flore flavo ; ovario brevi pulvillis sub-20 tomentosis et fulvo-setosis versus superiorem ovarii partem congestis ; sepalis tubi sub-13 exterioribus late oblanceolatis cæteris late obovatis cuspidatis ; petalis 8–10 late obovatis obtusis submucronatis ; stigmatibus 8 erectis ; bacca cuneato-pyriformi late umbilicata vix pulposa ; seminibus plerumque majusculis sub-regularibus crasse marginatis. (Tab. LXXV. fig. 9.–13.)

Var. *α*. NIGRICANS : obovata, viridior ; pulvillis magis approximatis ; aculeis brevioribus acute angulatis nigricantibus.

Var. *β*. BRUNNEA : obovata, glaucescens ; pulvillis remotis ; aculeis longioribus obtuse angulatis infra brunneis.

Along the Rio Grande near Santa Fé, var. *α*. (Fendler) ; var. *β*. common about El Paso, on the sandy ridges in the immediate valley of the river (Wright). — The northern plant has been correctly described in "Plantæ Fendlerianæ," with the exception of the flower, which probably refers to *O. Missouriensis*, or some allied species. The variety from El Paso has remarkably thick and glaucous joints, which in fall and winter often assume a purplish hue ; they are commonly 4 or 5 inches long and 2½–3 inches wide, the largest ones were 7 inches long and 4½ inches broad, sometimes they are more orbicular and shorter ; leaves 2½–3 lines long, thick in proportion ; pulvilli 1–1½ inch apart, with dirty yellowish or brownish bristles, only the lowest ones without spines ; spines usually 2–4, sometimes 4 or 5, and even more, in one bunch, 1–2 or sometimes 2½ inches long, terete or more or less flattened, but without sharp angles, often striate, light or dark brown below, whitish above, lower spines often entirely whitish. Flower 2¼–2½ inches in diameter ; ovary 10 lines long, 8 lines in diameter. Fruit 1¼–1½ inch long, with the lower part contracted, solid and seedless ; umbilicus rather shallow. Seeds very variable, usually over 2 lines in diameter, but sometimes smaller.

6. O. TENUISPINA, sp. nov. : diffusa seu adscendens ; articulis mediis seu majusculis obovatis basi attenuatis læte viridibus ; foliis gracilibus subulatis parvis, pulvillis subapproximatis setas breves graciles fulvas rufasve gerentibus, plerisque armatis seu inferioribus inermibus ; aculeis singulis binisve teretiusculis rectis gracilibus flexilibus albidis non raro basi apiceque fuscatis annulatisque, adjectis sæpe inferioribus tenuioribus albis, superiore in areolis superioribus porrecto, cæteris deflexis ; ovario clavato gracili pulvillis 25 versus apicem aggregatis griseo-villosis et fulvo-setosis stipato ; sepalis tubi sub-13 obovato-orbiculatis abbreviatis cuspidatis ; petalis 13 obovatis sub-emarginatis mucronulatis flavis basi aurantiacis ; stigmatibus 7–8 erectis virescentibus ; bacca minore oblonga profunde umbilicata, seminibus minoribus irregulariter angulatis anguste marginatis. (Tab. LXXV. fig. 14.)

Sand-hills on the Rio Grande near El Paso, from Doña Ana to San Elizario (Wright). Flowers in May. — About a foot high, spreading ; joints 3–6 inches long, 2–4 inches wide ; leaves 2 lines long or less, ½ line in diameter ; pulvilli ½ inch or in the largest specimens almost an inch apart, with short gray wool, and bright, reddish-brown, slender bristles, 1–1½ line long. Spines stiff and very straight, but flexible ; lowest ones ½–1¼ inch long ; upper ones 1½–2½ or rarely even 3 inches long, whitish or in some species brown toward the base or on the lower half, always darkish at tip. Flower 2½–3 inches in diameter ; ovary 1–1¼ inch long, slender ; sepals remarkably short ; petals rounded or somewhat emarginate, 1–1¼ inch long, 6–9 lines broad, yellow, with orange-red at base, turning all red on the second day of flowering. Fruit 1–1¼ inch long, with a very deep umbilicus, and without any contraction at base. Seeds [51] 1.5–2.0 lines in diameter, deeply notched at the hilum, very irregular. Distinguished from the nearly allied *O. phœacantha* by its thinner joints, slenderer and longer spines, larger flowers, different fruit, etc.

7. O. FILIPENDULA, sp. nov. : adscendens, glauca ; radicibus nodoso-incrassatis tuberiferis ; articulis minoribus diversissimis orbiculatis seu obovatis seu oblanceolatis tenuibus ; foliis minutis subulatis ; pulvillis approximatis in tomento albo setas numerosas tenuissimas penicillatas demum elongatas virescenti-stramineas gerentibus, plurimis armatis seu omnibus plus minus inermibus ; aculeis 1–2 albidis elongatis setaceis non raro subangulatis tortisque, 1–2 minoribus sæpe adjectis ; ovarii subcylindrici gracilis pulvillis 16–20 villo albo et setis parcis stramineis munitis ; sepalis tubi sub-8 lanceolatis, interioribus obovato-cuspidatis ; petalis 8 late obovatis retusis purpurascentibus margine pallidioribus ; stylo purpurascente ; stigmatibus 5 erectis flavidis ; seminibus minoribus tumidis anguste crasseque marginatis. (Tab. LXVIII.)

Alluvial bottoms of the Rio Grande, in rather fertile soil, near Doña Ana, above El Paso, and at San Elizario, below it ; also on alluvial prairies between El Paso and the Limpia (Wright). Flowers in May and June. — The tubers of the root, ½–1 inch thick, are long and cylindric, or oval, or globular swellings of the roots, strung upon thick fibres ; these tubers will sprout when planted. The stems are 6–12 inches high and spreading ; joints of a bluish, glaucous hue, more so than any other of our species, very variable in shape, orbicular, or even transverse to obovate and lanceolate ; often on the same plant, 1½–3 inches long, 1–2 inches wide, very much compressed ; leaves 1¼–1¾ line long ; pulvilli 4–6 lines apart, with a perfectly white tomentum, becoming gray when old, and numerous slender, greenish-yellow bristles, which finally become 2–3 lines long and very conspicuous. Sometimes the joints are entirely spineless, but usually they are armed with long, deflexed, very slender white spines, the longer ones 1–2 inches, the lower and shorter ones less than 1 inch in length ; ovary slenderer than in any other species known to me, an inch long, at top hardly more than 3 lines wide. Flowers about 2½ inches in diameter, purplish, without any mixture of

brick-red or yellow, as in the allied species ; the only other purple one of our *Platopuntiæ* is *O. basilaris,* which is of a yet purer and deeper purple color. Fruit unknown. Seeds have been sent which have germinated and produced plants which already after the first year showed the characteristic glaucous hue and the tuberous roots. These seeds also differ from all our other *Opuntia* seeds by their great thickness, and their remarkably narrow but thick and obtuse margin. They are only very slightly notched at the hilum, and have a diameter of 1.7–2.0 lines, with a thickness of 1.2 line.

8. O. MACRORHIZA, E. in Plant. Lindh., from between San Antonio and Austin (Lindheimer), is apparently well distinguished by its large tuberous roots, which even the young seedlings very soon begin to show ; but without these it is hardly distinguishable from *O. Rafinesquii,* E. of the Mississippi valley. I find the flower bud long-acuminate, and the stigmata always 5. (Tab. LXIX.)

9. O. RUFIDA, sp. nov. : erecto-patula ; articulis late obovatis seu suborbiculatis pubescentibus ; foliis e basi lata subulatis longe acuminatis ; pulvillis confertis griseo-villosis setas rufidas graciles numerosissimas penicillatas gerentibus inermibus ; floris flavi ovario obovato pulvillis 40–50 instructo ; sepalis tubi 20–30, exterioribus linearilanceolatis acuminatis, interioribus obovatis cuspidatis ; petalis (8 ?) orbiculato-obovatis obtusis erosis sæpe mucronulatis ; stigmatibus sub-7 abbreviatis in capitulum globosum congestis.

Common about Presidio del Norte, on the Rio Grande, on rocks and mountains (Bigelow) ; in the lower [52] valley of the Nazas, southeastern Chihuahua (Gregg). Flowers in May. — Stems 2–4 feet high ; joints 2–6 inches long, pale green, without any red or colored spots surrounding the pulvillus, as is said to be constantly the case in the allied *O. puberula* and *O. decumbens ;* leaves very slenderly acuminate, 2½ lines long, about twice the length of the axillary wool ; pulvilli thickly tomentose, and with an abundance of very delicate brown-red bristles, almost entirely covering the surface of young or not fully-grown joints, in adult ones about 4 lines apart. The flower described above was obtained south of the Rio Grande, in the Bolson de Mapimi ; ovary 10 lines long, flower 2½ inches in diameter, stigmata (green ?) about 1 line in length. This species is nearly allied to *O. microdasys*, which is common in cultivation, and specimens of which from Saltillo I have been able to compare. Our plant has more rounded and larger joints, more distant pulvilli, which bear reddish-brown (not yellow) bristles and longer leaves. From *O. puberula,* which seems to be yet nearer allied to it, it differs by the absence of spines, larger leaves, etc. Mr. Schott has noticed a pubescent *Opuntia* on the dividing ridge of the California Cordilleras, near the boundary line, and a suberect species in the Santa Cruz valley, in Sonora, about 3 feet high, both without spines. It is impossible to form any opinion where they belong, as no specimens have been saved.

10. O. BASILARIS, E. & B. in Pacif. R. R. : found by Mr. Schott in the Gila valley, and up the eastern slope of the California mountains. Flowers in May.

11. O. ARENARIA, sp. nov. : diffusa, adscendens ; radicibus crassis elongatis sæpe stoloniferis ; articulis minoribus obovatis crassis tumidis seu subcompressis tuberculatis nitide virentibus ; foliis minutis pulvillo vix longioribus ; pulvillis subconfertis parce albo-tomentosis setas plurimas gracillimas pallidas demum in articulis vetustis numerosissimas pulvinatas fulvas gerentibus, omnibus fere armatis ; aculeis superioribus 1–4 sæpe subangulatis, summo validiore porrecto albido seu fusco-variegato, cæteris brevioribus divergentibus seu deflexis albidis ; aculeis inferioribus 2–6 brevibus setaceis albis radiantibus ; floribus sulphureis ; ovario obovato pulvillis 20–30 setosis aculeolatisque instructo ; sepalis tubi 12–14, inferioribus late obovatis cuspidatis, superioribus obtusis ; petalis sub-8 obcordatis seu emarginatis sæpe mucronatis ; stigmatibus 5 mucronatis viridibus in capitulum collectis ; bacca oblonga ovata aculeolis inæqualibus armata ; umbilico infundibuliformi ; seminibus magnis irregularibus late crasseque marginatis. (Tab. LXXV. fig. 15.)

Sandy bottoms of the Rio Grande near El Paso (Wright). Flowers in May. — Roots 3–5 lines thick, at last ligneous, far spreading in the loose sand, and sometimes stoloniferous, which I have also noticed in some forms of *O. Missouriensis ;* stems spreading 2 or 3 feet, ½–1 foot high ; joints 1½–3 inches long, 1–2 inches wide, often terete or rather oval, or clavate (a specimen before me is 2½ inches long and ¾ inch thick), and always strongly tuberculate ; leaves about a line long ; pulvilli smaller than in *O. fragilis,* very sparingly tomentose, very bristly, the tawny bristles of the old joints covering almost the whole surface. Upper and longer spines 9–15 or even 18 lines long, white, with a yellow tip, or brown, yellow, or reddish at base and tip ; other spines 2–6 lines long, white. Flower 2–2½ inches in diameter ; ovary 9–12 lines long ; filaments greenish-yellow ; stigmata nearly 2 lines in length. Fruit dry, 10–14 lines long, contracted at top, with a deeply immersed umbilicus, and with spines of 1–5 lines in length. Seeds 2½–3 lines in diameter.

This species is nearly allied to the northern *O. fragilis,* but is distinguished by the larger and more strongly tuberculated joints, smaller pulvilli set with numerous bristles, the longer and slenderer spines, and the spinose fruit.

Subgen. 3. Cylindropuntia. [53]

Articuli teretes, clavati seu cylindrici. Aculei plerumque vaginati.

Flores parvi seu majores. Petala obovata seu orbiculata, rubra seu purpurea, rarius flava.

Stigmata 5–8, obtusa.

Bacca umbilicata, sicca seu subsicca, rarissime pulposa; inermis, seu setosa, seu aculeata; floris rudimentis dejectis seu persistentibus.

Semina sutura commissurali cincta, plerumque immarginata.

Embryo circa albumen copiosius subcircularis. Cotyledones contrariæ, incumbentes, haud raro obliquæ, interdum parallelæ, accumbentes.

The species forming this subgenus have an appearance so striking, and at the same time so distinct from the common type of *Opuntiæ*, that a generic separation has been attempted; but the flowers are so entirely identical, and in the fruit so little difference is observed, that it had to be abandoned. The only real distinction, and a permanent one as far as my observation goes, I find in the embryo. In *Cylindropuntia* it is less curved, not completing an entire circle, and surrounds a more copious albumen; in *Platopuntia*, on the contrary, it is somewhat spirally coiled, and the space for the albumen is thereby much smaller. It is worthy of remark that in *Cylindropuntia* the direction of the cotyledons is by far less constant than in other *Cactaceæ;* though usually incumbent, as in all other *Opuntiæ*, they are very often oblique, and not rarely accumbent, like those of *Echinocactus*. In *O. echinocarpa* I have found them invariably so.

§ 1. *Clavatæ.*

Stems prostrate; joints short and clavate, tuberculate, proliferous near the base; the ligneous tissue loosely reticulated, much like that of *Platopuntia;* spines more or less compressed and striate, the epidermis not or but slightly separating from them; flowers yellow and rather large; fruit always dry, crowned by the persistent remains of the flower, beset on the pulvilli with numberless spiny bristles.

12. O. Parryi, E. in Sillim. Journ. Dr. Parry observed this species on the eastern slope of the California mountains near San Felipe, and sent notes about it, an extract of which I published in Silliman's Journal. Since then Dr. Bigelow has collected it eighty or one hundred miles northeast of that place, near the Mojave River, and in his report a full account of the plant is given. Dr. Parry describes the joints as 4–8 inches long, ascending, with white spines only 6 lines long; flowers greenish-yellow, 1½ inch in diameter; stigmata green.

13. O. Emoryi, sp. nov.: prostrata; articulis cylindricis basi clavatis glaucis adscendentibus; tuberculis elongatis; pulvillis magnis setas paucas rigidas gerentibus; aculeis plurimis rufis seu fuscis demum cinerascentibus; interioribus 5–9 validioribus triangulatis compressis porrectis seu deflexis, superioribus solum suberectis; aculeis exterioribus 10–20 sæpe pluriserialibus undique radiantibus, superioribus gracilioribus teretiusculis, inferioribus rigidioribus compressis; floribus flavis extus rubellis; bacca ovata basi clavata flava pulvillis 35–50 setosissimis, stipata omnibus seu solum inferioribus aculeatis; seminibus numerosissimis valde inæqualibus plerumque transversis indistincte commissuratis. (Tab. LXX.–LXXI.)

Arid soil south and west of El Paso, especially between the Sand-hills and Lake Santa Maria (Wright, Bigelow), in Sonora (Wright), and on the lower Gila and in the Colorado desert (Schott). Flowers in August and September. — This is the largest and stoutest of our clavate *Opuntiæ*, with very numerous and long spines, spreading [54] largely, and growing 6–12 inches high, — forming a welcome retreat for the smaller Rodentia, snakes, etc., which, under the protection of its powerful spines, are secure against the attacks of their enemies. Joints curved, 4–6 inches long, 1–1½ inch in diameter. The tubercles are 1–1½ inch long, very prominent, and might be termed cylindric if they were not longitudinally attached to the stems. The upper tubercles of each joint and their spines are more fully developed than the others in this, as in all *Opuntiæ*. In those we distinguish 4 larger central spines; the upper one more erect, the lower one stouter, longer, broader, and deflexed. We often find a second upper one above, and a second lower one below the other; or the 4 central spines are surrounded by a circle of 6 or 8 somewhat smaller spines, which may be considered as an interior series of radiating ones; the exterior series consists of 10–20 shorter and more slender spines. But the arrangement of spines in this genus is never so regular as it is in other genera, especially in *Echinocactus*. Stoutest spines 1½–2½ inches in length, ¾–1 line wide, striated, flat on the upper, strongly carinate on the lower surface, so as to appear triangular; other interior spines 1–2 inches, exterior ones ¾–1½ inch long. Fruit 2–2½ inches long, an inch in diameter; larger pulvilli 2–2½ lines in diameter; bristles whitish or reddish, 3–4 lines long; 10 or 12 spines, 4–8 lines in length, are mixed with the bristles on all or only on the lower pulvilli. Seeds, very different in size and shape, in the same fruit, 2½–3 lines in diameter or more, often transverse or angular, blunt or beaked; cotyledons generally oblique, sometimes accumbent, contrary to the usual arrangement in this genus. The specimens from the lower Gila and the Colorado must, I have little doubt, also be referred here. Plant 12–18 inches high, far-spreading, of a dull grayish-green color; joints similar to those described above; spines only

1–1½ inch long; flowers sulphur-yellow, externally tinged with purple, 2 or 2½ inches in diameter; pulvilli of the ovary over a line in diameter, white-tomentose, supported by subulate leaves (2 lines long) bearing short white bristles and reddish spines; exterior sepals oblanceolate, cuspidate, red-brown, interior ones with yellow and red petaloid margins; petals yellow, with red tips; fruit not as large but even more spiny than in the specimens from El Paso.

This species also has been named in honor of Colonel W. H. Emory, who, in his different expeditions to the extreme southwestern parts of our territory, always exerted himself for the advancement of our knowledge of the natural history of these regions.

14. O. Schottii, sp. nov.: articulis breviter clavatis adscendentibus; tuberculis elongatis; pulvillis paucisetosis; aculeis scaberrimis rubellis, interioribus 4 cruciatis, superiore triangulato erecto, cæteris ancipitibus supra planis subtus convexis, inferiore latiore; aculeis exterioribus 8–10 radiantibus valde inæqualibus; bacca obovato-clavata, pulvillis 35–40 setas suberectas aculeosque paucos gerentibus; seminibus angulatis rostratis transversis, commissura lineari indistincta. (Tab. LXXIII. fig. 1–3.)

Abundant on the arid hills near the Rio Grande, between the San Pedro and Pecos rivers (Wright, Schott). — The specimens gathered in July and September were all in fruit. Joints 2 inches, tubercles 8–9 lines long; pulvilli, even in the oldest joints, with few bristles. Spines rougher than in any other allied species, red, the broader ones with a white margin, 1½–2 inches long; smaller radiating spines 4–9 lines long, almost surrounding the inner one. Ovary with white-tomentose pulvilli and short bristles; those in the fruit become a little longer, but are confined to the upper half of the pulvillus and are erect, while in all the allied species they are much more numerous and stellately spread in all directions. Seed a little over 2 lines in the transverse diameter; cotyledons in all [55] the seeds examined oblique. Dedicated to one of its discoverers, whose name I have often had occasion to mention.

Dr. Gregg has sent a similar plant from San Luis Potosi, Mexico, which, though growing 7 or 8 degrees farther south, I must consider the same as *O. Schottii*. Its joints 2 inches long; tubercles 10–12 lines long; 4 central spines ancipital or triangular, 12–20 lines long, much less rough, 8–12 exterior spines of very different sizes. (Tab. LXXIII. fig. 4.)

15. O. Grahami, sp. nov.: radicibus crassis fusiformibus; articulis breviter clavatis adscendentibus læte viridibus; tuberculis oblongis; foliis e basi ovata abrupte acuminatis; pulvillis albo-tomentosis setas demum numerosas elongatas rigidas gerentibus; aculeis gracilibus scabris rubellis demum cinereo-fuscis, interioribus 4–7 robustioribus scabris teretiusculis seu 4-angulatis seu rarius compressis, exterioribus 4–6 multo minoribus; flore flavo; ovarii pulvillis sub-30 albo-tomentosis setosis; bacca ovata setosissima; seminibus regularibus vix rostratis, commissura lineari indistincta. (Tab. LXXII.)

Sandy soil in the bottom of the Rio Grande, near El Paso, and for a distance of about one hundred miles along the river (Wright, Bigelow). Flowers in June. — Roots often 6 inches long and an inch thick, tapering, single or divided; joints 1½–2 inches long, ¾ or at most 1 inch in diameter; tubercles 6–7 lines long; leaves similar to those of *O. vulgaris*, short and thick, nearly a line in diameter at base and about twice as long; larger spines 1½–2 inches long and spreading, scabrous, slenderer than in any allied species. Flowers apparently 2 inches in diameter, and, like the fruit, very similar to those of *O. clavata*. Seeds 2.5–2.8 lines long, with a linear and often very indistinct commissure; cotyledons in the seeds examined regularly incumbent.

This species, peculiar to an interesting part of our boundary, has been named in honor of the gentleman who was for a time chief of the scientific corps of the Commission, and by whose orders this, with many other species of *Cacti*, has been sent to me.

16. O. bulbispina, sp. nov.: radicibus fusiformibus; articulis parvis ovatis vix clavatis sæpius ex apice proliferis fragilibus; pulvillis parce setosis, junioribus laxe villosis; aculeis teretiusculis scabrellis basi bulbosis, interioribus 4 cruciatis, inferiore longiore, exterioribus 8–12 radiantibus. (Tab. LXXIII. fig. 5–6.)

Near Perros Bravos, north of Saltillo (Gregg). — Spreading masses 2–4 feet in diameter; joints 9–12 lines long, 6 lines in diameter, often proliferous at the upper end; tubercles 3–4 lines long; interior spines 4–6 lines, exterior ones 1½–3 lines in length. This species has the subcylindric joints, the reticulated ligneous texture, and the scabrous spines of the clavate *Opuntiæ*, but its mode of ramification is rather different, and the form of the joints is more ovate than clavate. Perhaps it belongs rather to Prince Salm's section *Glomeratæ*, and near *O. pusilla* from South America.

§ 2. *Cylindricæ.*

Stems ascending or usually erect, much branched; joints cylindric or tumid, tuberculate or sometimes almost smooth. The ligneous tissue is compact, and either (in spec. 17–24) forms a reticulated hollow tube, in which the meshes correspond with the tubercles, and which by age becomes more and more solid and massive, or it is (in spec. 25–28) reticulated only when quite young, and soon becomes quite dense. The spines are almost always terete, and are always covered with a loose glistening sheath. Flowers purple or rarely yellow, large, or usually

middle-sized or (in the two last species) quite small. The fruit is unarmed, somewhat fleshy or leathery, rarely [56] pulpy, throwing off the dead flower, or very rarely retaining it. In a few species it is dry and spiny.

17. O. ECHINOCARPA, E. & B. in Pacif. Rail. Rep., Var. β. MAJOR: elatior; articulis elongatis basi attenuatis; tuberculis oblongo-linearibus; setis tenuibus penicillatis; aculeis longioribus laxius vaginatis paucioribus; bacca globosa seu basi clavata pulvillos pauciores gerente.

In the deserts on both sides of the Colorado and in Sonora (Schott). — This form looks very different from the plant collected by Dr. Bigelow, and described in the Report of Captain Whipple; but the very peculiar seeds which fortunately have been obtained by both collectors prove them to be identical. Dr. Bigelow's plant is a low straggling shrub; but Mr. Schott's is 4 or 5 feet high, with divaricate branches, joints 8–10 inches long, with elongated tubercles (6–9 lines in length), fine long bristles, and longer spines with looser sheaths. The 4 central larger spines are 1–1¾ inch long; the 4–8 radiating spines, on the contrary, shorter. The fruit is longer, and bears only about 25 pulvilli, as spiny as in the original form.

18. O. SERPENTINA, E. in Sillim. Journ. 1852: diffusa; ramis elongatis subverticillatis divaricatis adscendentibus; tuberculis prominentibus ovatis; pulvillis albido-setosis; aculeis 7–9 vaginatis albidis seu rufescentibus porrectis, infimis deflexis; floribus minoribus flavis extus rubellis; ovario depresso pulvillis sub-20 stipato; sepalis 10 late obovatis breviter cuspidatis; petalis sub-5 obovatis integriusculis mucronatis; stigmatibus 8 erectis; bacca sicca subhemisphærica villosa aculeatissima late et profunde umbilicata flore emarcido sæpe coronata.

Dry hills near San Diego, California (Parry); generally nearer the sea-coast than *O. prolifera*, and not gregarious, nor so common as that species (Schott). — Stems 1–1½ inch in diameter, suberect, 4–5 feet high, or almost prostrate; joints 6–12 inches long, ¾–1¼ inch thick, somewhat verticillate, divaricate; spines 3–9 lines long, sheathed, light-yellowish or rusty, upper ones stellate-divaricate, lower one closely deflexed. A single flower was collected by Mr. Schott in October: it is not quite 1½ inch wide, the ovary depressed, about 8 lines high, with 20 areolæ bearing dirty-yellowish wool, yellow bristles, and 5–7 reddish-brown sheathed spines, 2–4 lines in length; sepals externally yellowish-green tinged with purple, even the lower ones unusually obtuse or short cuspidate; petals rounded, scarcely 9 lines long, yellow above, red at tip, ascending and forming a cup-shaped corolla; stigmata (green?) 2 lines long. Fruit saucer-shaped, deeply and broadly umbilicate, yellowish-brown, very spiny, and "long woolly."

19. O. PROLIFERA, E. l. c.: caule arborescente; ramis numerosis horizontalibus divaricatissimis; articulis ovatis seu ovato-cylindricis tumidis fragilibus versus ramorum apicem congestis perviridibus, inferioribus demum refractis brunneis; tuberculis obovato-oblongis prominulis; pulvillis ovatis tomentosis, vetustioribus stramineo-setosis; aculeis 8–10 obscuris stramineo-seu rufo-vaginatis, singulo subcentrali, cæteris patulis stellatis, inferioribus brevioribus; flore rubro; sepalis late ovatis; petalis oblongo-obovatis; stigmatibus erectis; bacca ovata umbilicata aculeolata sæpissime sterili proliferaque.

On arid hills about San Diego, California, near dry beds of streams, forming impassable and extensive thickets (Parry, Schott). — These thickets are likened by Mr. Schott to unapproachable coral reefs. Stem 2–4 and sometimes even 6–7 inches thick, and 3–10 feet high; the wood forms a reticulated hollow tube, with short meshes, which in old plants finally become obliterated. The tumid joints are 3–6 inches long, 1½–2 inches in diameter, clustered at the end of the branches; the younger ones easily break off and stick to the skin of men or animals. The [57] tubercles are obovate, narrowed below, and about 6 lines in length, arranged in 5 or 8 spirals; areolæ oval, somewhat immersed, with bunches of fine straw-colored bristles at the upper edge. Spines very variable, always with large loose sheaths: in a specimen before me I find 7–8 radiating spines, the upper ones and the central one equal, about 12–14 lines long, the lower ones 6–8 lines long, with a few still smaller ones below; in other specimens the upper spines are reduced in size or are wanting. Flowers dark-red, salverform, about 1½ inch in diameter. Fruit said to be spinulose, but always abortive, — as Dr. Parry has often satisfied himself, — and usually proliferous.

This species somewhat resembles *O. arborescens*, but is easily distinguished by the short and tumid joints, short tubercles, spiny fruit, etc. The alliance with the next species and with *O. Bigelovii* is much closer. They represent the same type east of the California mountains that this does on the Pacific coast; just as *O. echinocarpa* in the Colorado valley represents another type, which has on the coast its representative in *O. serpentina*.

20. O. FULGIDA, sp. nov.: caule erecto arborescente flexuoso; ramis divaricatis; articulis ovatis seu ovato-cylindricis tumidis glaucescentibus ad ramorum apicem congestis; tuberculis ovato-oblongis sub-prominulis; foliis ovatis cuspidatis; pulvillis pulvinatis ovatis tomentosis setas pallide stramineas et aculeos 7–9 subæquales laxe vaginatos undique porrectos stellatos gerentibus; floris parvi purpurei ovario ovato pulvillis 25–30 albo-tomentosis prædito setis aculeisque destituto; sepalis tubi 8–10 orbiculatis obtusis crenulatis; petalis 8, exterioribus cuneatis retusis crenulatis, intimis lanceolatis acutis cætera superantibus; stigmatibus 5 erectis; bacca ovata pulposa vix tuberculata plane umbilicata sæpissime sterili et fasciculatim prolifera; seminibus parvis irregulariter angulatis rostratis anguste commissuratis; cotyledonibus regulariter incumbentibus. (Tab. LXXV. fig. 18.)

Throughout all the Sierras in western Sonora, named by the inhabitants "Vela de Cojote," whence the specific name; which, however, would be just as appropriate for most other cylindric *Opuntiæ*, which are often visible for several miles when the sun strikes the glistening sheaths of their spines. Flowers in July and August. — Stems 5–12 feet high, flexuous with few divaricate branches; joints clustered at their ends, 3–8 inches long and often 2 inches in diameter, "dull-grayish, inclined to olive;" tubercles ovate-elongate, 6–7 lines long; leaves thick and only about 1 line long; spines almost equal in length (1–1¼ inch), stellate and not much deflexed, completely hiding the surface of the young joints; ovary about 10 lines long. Flower cup-shaped, mostly less than an inch in diameter. Fruit a plump fleshy berry, oval, rounded, not or only slightly tuberculated, 1–1¼ inch long, a little less in diameter, and entirely spineless; characterized by the large white tomentose pulvilli. Seeds 1–1½ line in diameter, or with the beak often 2 lines long, much compressed, and thin and very angular, often oddly shaped. The fruit is not rarely sterile and proliferous, and becomes pendulous from the weight of the young sprouts attached to it.

21. O. WHIPPLEI, E. & B in Pacif. Rail. Rep., var. β. SPINOSIOR: elatior, erecta; articulis cylindricis; tuberculis ovatis confertis; pulvillis parce tomentosis, vix setosis; aculeis 12–14 stramineo-vaginatis stellato-porrectis; flore rubro; ovarii ovati tuberculati pulvillis 20–30 albo-tomentosis setas stramineas et aculeolos paucos mox deciduos gerentibus; sepalis 8 orbiculatis cuspidatis; petalis 8–10 spathulatis cuspidatis; bacca subglobosa leviter tuberculata inermi; seminum commissura lineari.

From the Gila south to the Santa Cruz River and Tucson, and farther east (Schott). Flowers in June. — Stems 6–10 feet high; joints 4–12 inches long, ½–¾ inch thick, covered with ovate or rather rhombic tubercles; [58] spines much more numerous in this variety than in the original form, found by Dr. Bigelow farther north, 6–9 lines long. Flowers 1¼–1½ inch wide, cup-shaped. Seeds nearly 2 lines in diameter, larger than in the northern form, with a very sharply marked linear commissure.

22. O. ARBORESCENS, E. in Wisliz. Rep.: caule arborescente erecto reticulato-lignoso; ramis verticillatis horizontaliter divergentibus seu pendulis; articulis verticillatis plerumque ternis quaternisve cylindricis perviridibus; tuberculis elongatis cristatis; foliis teretibus elongatis patulis; pulvillis ovatis pulvinatis breviter tomentosis vix setosis; aculeis 8–30 corneis seu fuscis stramineo-vaginatis undique stellato-porrectis, 1–8 interioribus longioribus laxius vaginatis, centrali sub-deflexo, exterioribus debilioribus arcte vaginatis; flore purpureo magno; ovarii subglobosi tuberculati pulvillis 20–25 breviter tomentosis setas minutas et aculeolos paucos erectos deciduos gerentibus; sepalis tubi 8–13 obovatis obtusis medio virescentibus margine purpureis; petalis 10–12 obovatis obtusis retusisve; filamentis purpureis; stigmatibus 8; bacca globosa seu hemisphærica tuberculis prominentibus cristata late umbilicata inermi subsicca flava; seminibus regularibus anguste commissuratis; cotyledonibus incumbentibus seu rare obliquis. (Tab. LXXV. fig. 16–17.)

This species extends from the upper waters of the Arkansas and the Platte rivers deep into Mexico, and from the plains east of the Llano Estacado (200 miles east of the Pecos) to Zuñi, 150 miles west of the Rio Grande, about 15 degrees of latitude and 8 of longitude. Flowers in May and June. — North and east this species is only about 5 feet high, but farther south it is said to become 20 or 30 feet high; even the old trunks continue greenish and spiny. The massive ligneous skeleton is always characterized by the elongated-rhombic meshes and the verticillate insertions of the branches; in very old specimens the cavity of the tube and the meshes become almost obliterated by the filling in of ligneous layers. The roots are often somewhat tuberous by a swelling of the fibres. Joints 2–6 inches long, less than an inch in diameter; tubercles compressed-cristate, elevated, 7–9 lines long; leaves 6–10 lines long, hardly a line in diameter. Spines very variable in number and size; sometimes we find only 8–12 spines, not half an inch long, so that the plant from a distance appears spineless, but more frequently 20–25 or even more spines occur, the longest middle ones deflexed, and 8–10 or rarely 12–14 lines in length, other spines spreading all around, 4–8 lines long. The beautiful purple flowers are 2½–3 inches in diameter, and often profusely cover the tree; the stigmata have a length of 3 or 3½ lines. The fruit is about an inch long in all dimensions; umbilicus wider or narrower, shallower or deeper, according to the greater or smaller prominence of the upper tubercles of the fruit. Seeds 1½–2 lines in diameter, usually of a regular shape, with little or no beak; the commissure distinct, and between 0.1 and 0.2 line broad; cotyledons almost always regularly incumbent, rarely somewhat oblique. Sometimes 3 cotyledons are observed in the seeds of this species, as is also the case in many others.

23. O. MAMILLATA, A. Schott in litt.: caule arborescente reticulato-lignoso divaricato-ramosissimo; articulis ovato-cylindricis crassis abbreviatis retusis perviridibus; tuberculis ovatis tumidis prominentibus; foliis ovatis abbreviatis cuspidatis; pulvillis ovatis albo-tomentosis setas brevissimas seu nullas gerentibus; aculeis 4–6 gracilibus brevibus arcte vaginatis stramineis, plerisque deflexis; flore parvo purpureo; ovarii ovati pulvillis 18–24 pulvinatis albo-tomentosis; sepalis tubi sub-8 orbiculatis; petalis 8 late obovatis abbreviatis; filamentis exterioribus dilatatis (sterilibus?); stigmatibus 7–8 erectis; bacca ovata plane umbilicata pulvillis magnis albo-tomentosis inermibus notata; seminibus parvis angulatis vix rostratis anguste commissuratis valde compressis. (Tab. LXXV. fig. 19.) [59]

South range of the Sierra Babuquibari, in Sonora, and southeastward, in fertile valleys (Schott). Flowers in July and August. — This peculiar species is more tree-like than any other Sonorian *Opuntia*. It has a distinct trunk and a dense top, much like any other ordinary tree, though only 5 or 6 feet high; the joints are 3 or 4 inches long and 1½ inch in diameter; the swelling tubercles much resemble those of a *Mamillaria*, whence the name; the thick leaves are scarcely a line long; spines few, 3–9 lines long, sometimes almost wanting. The flowers are hardly an inch in diameter, and of a bright pink or purple color; the ovary is 8 or 9 lines long, and the fruit of the same length, slightly tuberculate, in all the specimens before me unarmed (according to Mr. Schott's notes, "spiny"). Seeds 1–1½ line in each dimension, often higher than broad, very irregular, remarkably similar to those of *O. fulgida*, but scarcely beaked, and still more compressed; cotyledons incumbent or often somewhat oblique.

24. O. THURBERI, sp. nov.: frutescens, erecta; articulis cylindricis gracilioribus tuberculatis; tuberculis oblongo-linearibus minus prominulis; pulvillis sub-orbiculatis breviter fulvo-tomentosis vix setosis; aculeis 3–5 brevibus obscuris stramineo-seu fulvo-vaginatis lateraliter divergentibus, infimo robustiore deflexo; flore miniato; ovarii clavati tuberculati pulvillis 18–20 tomentosis brevissime setosis et parce aculeolatis; sepalis tubi obovatis cuspidatis; petalis erectiusculis obovato-spathulatis obtusis retusisve; stigmatibus 7 brevibus crassis erectis.

Near Bacuachi, Sonora (G. Thurber). Flowers in June. — Similar in some respects to *O. arborescens;* but the slender joints only about 6 lines in diameter; tubercles 9 lines long; spines 3–8 lines long, the lowest one the stoutest! and deflexed. The ovary is about 10 lines long, and bears on some of the pulvilli 1 or 2 spines, which are evidently deciduous, as we see them in *O. arborescens* and *O. Whipplei*. The flower is 1½ inch in diameter, dull brick-red, salver-form, and opens much less than that of *O. arborescens*, which is pure purple; stigmata 1–1½ line long.

This species I have named for its discoverer, Mr. George Thurber, who, in Mr. Commissioner Bartlett's party, traversed Sonora, and gathered many interesting plants in that then almost unknown country.

25. O. WRIGHTII, sp. nov.: caule frutescente erecto, juniore reticulate, seniore compacto-lignoso; ramis adscendentibus; articulis cylindricis gracilibus sub-tuberculatis; tuberculis elongatis depressis; foliis elongatis subulatis patulis; pulvillis orbiculatis albo-tomentosis setas gracillimas penicillatas gerentibus; aculeis singulis (seu rarius 1–2 superioribus minoribus adjectis) porrectis seu paulo deflexis e cinereo rubellis vagina straminea decidua indusiatis; flore miniato; ovarii obovati pulvillis 15–18 albo-tomentosis setosisque; sepalis tubi 9–12 orbiculatis, exterioribus cuspidatis, interioribus obtusis; petalis sub-8 late obovatis emarginatis; styli crassi stigmatibus 6–7 brevibus adpressis.

Common on steep rocky mountain-sides on the Limpia (Wright), and along the Rio Grande from Presidio del Norte to the Pecos (Parry, Bigelow); also southward, in Mexico (Gregg). Flowers in June and July. — A shrub, 2–4 feet high, about 1 or 1½ inch thick below, intermediate between *O. arborescens* and *O. frutescens* in size, structure of stem, and arrangement of spines. Branches few; joints 4 lines in diameter; tubercles flat, 7–9 lines long; leaves about 5 lines long. Spines 8–10 lines in length, generally single or with 1 or 2 small and divergent ones above; in one specimen before me those upper spines are almost as stout and long as the lower one. Flowers about 1 or 1¼ inch in diameter; ovary 7–8 lines long. Fruit unknown.

This pretty species of *Opuntia* bears a name which has been often mentioned in these pages, and which is [60] forever inseparably connected with the botany of our Southern boundary.

26. O. ARBUSCULA, sp. nov.: caule erecto arborescente dense lignoso apice ramosissimo capitato; ramis divaricatis elongatis teretibus etuberculatis; articulis junioribus læte viridibus leviter tuberculatis; tuberculis oblongo-linearibus depressis; pulvillis magnis orbiculatis albo-tomentosis; setis parcis gracillimis penicillatis; aculeis singulis (seu subinde binis lateralibus) porrectis demum deflexis stramineo-seu fulvo-vaginatis, rarius une alterove breviore inferiore deflexo adjecto; flore flavo-virescente; ovarii clavati pulvillis 16–18 albo-tomentosis vix setosis; sepalis tubi sub-8 orbiculatis cuspidatis seu mucronatis; petalis sub-5 spathulatis, staminibus extus in staminodia latiora subulata transeuntibus; stigmatibus 5 brevibus erectis.

On the desert heights, near Maricopa village, on the Gila (Schott). Flowers in June. — A truly arborescent species, 7–8 feet high, with a solid ligneous trunk, 4–5 inches thick, smooth green bark, and a top formed by the numerous slender and divaricate branches; ultimate joints 2–3 inches long, about 4 lines in diameter; tubercles flat and indistinct, about 6 lines long; spine 9–12 lines long. Ovary, in my specimen, 10 lines long and only 4 lines in diameter, without any spines; but the fruit is described by Mr. Schott as "bristly, crowned by the persistent flower." Flower apparently nearly 1½ inch in diameter; petals few, 9 lines long and 4 lines broad, greenish-yellow, tinged with red. Stamina and staminodia (perhaps what I consider so are but the broader filaments of the exterior fertile stamens) finally breaking off near their base, leaving a rough surface. The name of this species indicates a small tree.

27. O. FRUTESCENS, E. in Plant. Lindh., was collected abundantly in all western Texas and southern New Mexico. For a fuller account and a figure, see Engelmann and Bigelow's paper on the *Cactaceæ* of Captain Whipple's Pacific Railroad Exploring Expedition Report.

28. O. TESSELLATA, E. in Pacif. Rail. Rep. (*O. ramosissima*, E. in Sillim. Journ. 1852). — This curious species was first noticed by Dr. Parry, and described, as above cited, in an account of his California *Cactaceæ*, under the name of *O. ramosissima;* which, being deemed an improper name in a section where all could claim it with equal and some with greater justice, it was changed in the account of Dr. Bigelow's plants, who brought specimens of the wood, the branches, and the fruit. Mr. Schott, the third botanist who collected it, was fortunate enough to find the flowers. Living plants are yet a desideratum in our gardens.

This species grows in arid sandy soil, from the Sierra Madre south of the Gila to the lower Colorado, Bill Williams's Fork, and the California mountains. Mr. Schott found it in September with flower and ripe fruit. The flower is purple, about 6 lines in diameter; the clavate ovary is of the same length, and bears 40 or 50 very tomentose but scarcely spiny or bristly pulvilli; the 5 petals are almost orbicular; the exterior filaments are broad and persistent (sterile staminodia?); 5 stigmata short and erect. The fruit resembles very much those of the clavate *Opuntiæ;* it is 9 or 10 lines long, dry, ovate, and contracted above; the narrow and deep umbilicus contains the remains of the flower, the above-mentioned broad filaments being most conspicuous; externally it is covered with a profusion of hair-like flexuous bristles of a red-brown color, 2–3 lines in length, mixed with dense wool. Seeds thick, with a broad spongy commissure, 1.8–2.0 lines in diameter. Mr. Schott collected in May other greenish-yellow flowers from similar bushes, which he considers as of a distinct variety. The ovary in these flowers appears elongated, and is probably sterile, and would have become persistent and proliferous, as we find it in many other *Opuntiæ;* so that this green-flowered form probably is not a variety of our species, but a degeneration.

CORRECTIONS TO THE CACTACEÆ OF THE BOUNDARY.

A voyage to Europe, since my paper has gone through the press, has afforded me the advantage not only of the per- [73] sonal intercourse with numerous men of science and many cultivators, but also of an actual examination of various large collections of living *Cactaceæ*. Some of the results of my investigations, as far as they bear upon the "Cactaceæ of the Boundary," have been incorporated with the list of corrections of typographical errors.

Page 2, line 22 = page 177, line 9. *Sepalis petalisque.* It will scarcely be necessary to inform the reader that the numerous foliaceous integuments of the cactus-flower do not very properly range under the divisions of *sepals* and *petals*. For convenience' sake, however, the exterior more herbaceous ones are called *sepals*, and the interior ones, with thinner texture and brighter color, are named *petals*. The "sepals" usually are more numerous than the "petals," and in most genera form a complete transition from the organs — which on the stem represent the leaves (usually with their spiny appendages) — to the petals. On the ovary they usually resemble the former, which, among other reasons, seems to give color to the suggestion of Zuccarini mentioned in the note to page 39, line 29 = page 200, line 52.

Page 4, line 12 = page 177, line 22. I follow De Candolle in giving, as one of the characters of the species, the number of the more distinct spirals of the tubercles in *Mamillariæ* and cylindric *Opuntiæ*, just as we describe the number of ribs of *Echinocacti* or *Cerei*. It is now well known that no character can be deduced from the direction of the spirals to the right or left. It is also known that the greater or less prominence of one or the other spiral depends on the number and crowded state of the tubercles and the comparative thickness and elongation of the axis. The characters deduced therefrom are not absolute, nor are they quite scientific. It would be more exact to state the phyllotactic law of the arrangement of the tubercles. I would have to say that *M. micromeris* has its tubercles arranged after the $\frac{13}{34}$ or even the $\frac{21}{55}$ system. But I suppose the plan followed by me is more intelligible to most readers, and not much less clear to the scientific phyllotaxist.

Page 5, line 4 = page 178, line 8. *M. microthele* is well distinguished from our species by its much larger tubercles and 2 unusually stout and short central spines.

Page 5, line 36 = page 178, line 33. The pale yellow spines look like fibres of raw silk, and form a silk-like tuft, but are not *tipped by a brush*, as the original edition had it.

Page 7 = page 179. *M. Grahami* is nearly allied to *M. Schelhasii*, Pfr., from Real del Monte, Mexico. The [74] next species, *M. Wrightii*, is closely allied to *M. zephyranthoides*, Scheidw., from Oaxaca, Mexico. Without the flower, however, and especially without the fruit and seed, — which latter has never been paid attention to, — these plants can scarcely be sufficiently well characterized nor their relationship ascertained.

Page 9 = page 180. *M. sphærica* is almost too closely allied to the Mexican *M. Longimamma*, DC.

Page 10, line 41 = page 181, line 54. The plant here described as a variety exactly agrees with some original specimens of *M. Scheerii* preserved in the collection of Prince Salm-Dyck. It will not be useless here to urge the importance of preserving the dead cactus plants, or, as these specimens are fancifully called, the "skeletons." I have been materially assisted by being able to examine the skeletons of some authentic original specimens, of which no living ones are now found in the gardens; but generally the dead plants are thrown aside, and a description, often vague or incomplete, or at best an indifferent figure, is all that is left for future identification. Unscrupulous gardeners and traders do their best to increase the confusion.

Page 12 = page 183. *M. pectinata* is probably not sufficiently distinct from *M. radians*, DC., and, with it and both the following species (*M. Echinus* and *M. scolymoides*), may belong to *M. cornifera*, DC.; the two former being the forms without, and the three latter those with, central spines.

Page 14 = page 183. *M. scolymoides*. A specimen brought by Dr. Bigelow has flowered. The flower greatly resembles that of *M. pectinata*, figured on Plate XI., but is more of a reddish than yellow tinge. Dr. Poselger assures me that they also vary with white or whitish flowers. *M. tuberculosa* is clearly identical with *M. strobiliformis*, Scheer in Salm, Hort. Dyck (1850), as I have ascertained by a careful examination of the original specimen (now dead) in the collection of Prince Salm. Mr. Scheer's name, having the priority, must be substituted for mine.

Page 17 = page 186. *M. heteromorpha*, Scheer in Hort. Dyck, 1850, is the same species, to judge from the "skeleton" of the original specimen in Coll. Salm. — *Anhalonium*. As the genera of *Cactaceæ* are now constituted, *Anhalonium* will probably better be kept distinct from *Mamillaria*. A second section of the genus, with flattened tubercles arranged into ribs, would comprise *Echinocactus Williamsii*, Lem. The tufts of dense wool on this plant do not represent the (absent) spines, but are axillary productions, surrounding and partly including the flower and fruit. The ovary is perfectly naked, as in other *Anhalonia* or *Mamillariæ*, which has already been noticed by others. The interesting *Leuchtenbergia Principis*, Fisch., may possibly have to be reduced to a third section of this genus. The flowers being borne just below the tip of the nascent tubercles (which, when full grown, are 3 to 6 or 7 inches long, prismatic or awl-shaped, and bear at the tip several flat flexible scales in [75] place of spines), the plant can have no affinity with *Cereus*. If the ovary should prove to be naked, the large flower and elongated tube would not be sufficient to separate it from *Anhalonium*. Mr. Labouret, in his "Monographie des Cactées," Paris (without date, probably 1853), page 162, notices the position of the flower. I have seen the young buds below the apex of the tubercle at Kew, and the scar left by the fallen fruit at Mr. Haage's in Erfurt, but could not meet with either flower or fruit itself. — *A. fissuratum* is very nearly allied to the Mexican *A. sulcatum*, Salm (*A. Kotchubei*, Lem.), of which it seems no living nor dead specimen is at present extant in Europe. The upper surface of the tubercle of *A. sulcatum* is said to be deeply grooved, the groove being filled with silky tomentum; otherwise the tubercles are said to be smooth.

Page 21 = page 188. Fig. 12 exhibits the enlarged *funiculi*, which consist of a loose juicy tissue. It seems that in most *Cactaceæ* the *funiculi* toward maturity become large and juicy. Usually their cells then burst, and form the so-called pulp, in which the seeds are described as nestling, — "semina nidulantia."

Page 23, line 14 = page 190, line 6. It ought to have been mentioned that the lower central spine is as long as the others, or more commonly greatly exceeds them.

Page 26 = page 192. *E. horizonthalonius*. Numerous original specimens of this plant, living and dead, examined in European collections, leave no doubt of the entire identity of the different forms, which can scarcely be counted as varieties.

Page 38, line 31 = page 200, line 6. *C. pentalophus* is *erect*, "10–15 inches high," only when so trained. It [76] grows naturally like *C. Berlandieri*, *C. procumbens*, and *C. Ehrenbergii*, Pfeif., all of which closely resemble one another in habit. *C. pentalophus* has a 5-angled stem of bright green color, with short spines; *C. Ehrenbergii* is usually 6-angled, pale green, with numerous long and setaceous spines. Flower and fruit of either seem to be unknown.

Page 39, line 21 = page 200, line 45. The root of young plants forms a single globose tuber; in older ones it consists of a cluster of several oval or cylindric tubers, sometimes 6 or 8 in number, 1–1½ inch in diameter and 2–3 inches long.

Page 39, line 29 = page 200, line 52. After "family," add: "or the specimen observed by Dr. Poselger offered one of those rare anomalies (one of which, found by Zuccarini in *Cereus serpentinus*, was figured by him in the Annals of the Munich Academy) where the ovary actually forms the continuation and termination of a branch, by which the sagacious observer just mentioned was induced to consider the so-called ovary of *Cactaceæ* itself a branch, with the real ovary immersed in it. But how would he view it in *Mamillaria?*"

Page 41, line 13 = page 202, line 1. This is *C. Pottsii*, Salm, Hort. Dyck, a later name.

Page 46, line 26 = page 205, line 28. Cultivated specimens of *O. grandis* are erect, because, tied to the stake, they are not permitted to grow otherwise. Their white spines seem to grow dark very soon, and the smaller number and greater distance of the spines may be owing to the influence of cultivation. There is therefore scarcely a permanent character left to distinguish the new species from this one.

Page 47, line 8 = page 206, line 7. This *margin* is the enlarged and indurated *funiculus* itself, which, by a lateral expansion, envelopes the seed proper and forms its exterior bony coating. This dilatation of the *funiculus* takes place long before the flowering period; it covers the *ovulum* so completely that only two small lateral openings remain, which lead to the *orifice*. After Mr. Payen and others had already noticed this expansion of the *funiculus*, Dr. Caspary, of Bonn, lately has more completely investigated its nature. It appears that in many if not in all other *Cactaceæ*, the *funiculus* is bent over the orifice of the *ovulum*, partly covering it (I have seen it in some *Mamillariæ*, *Echinocacti*, and *Cerei*); but that only in *Opuntiæ* it expands into an exterior seminal coat, which is distinguished from *arillus* proper only by its being already fully formed [77] at the flowering period.

Page 58 = page 213. *O. arborescens* seems to be very closely allied if not identical with *O. rosea*, DC., and *O. imbricata*, DC. The former is described from a figure; the flower and fruit of the latter remain unknown, — so that it is difficult if not impossible at present to solve these doubts.

Page 59, line 30 = page 214, line 22. *O. Wrightii* may not be different from *O. Kleiniæ*, DC., from Mexico, long cultivated in Europe, the flower of which does not seem to be known.

Page 60, line 21 = page 204, line 53. *O. frutescens* seems identical with *O. gracilis*, Hort. Monac, and *O. virgata*, Hort. Vind., the flower and fruit of which are unknown. It is stated that the spines of *O. gracilis* are not vaginate. This is no doubt

a mistake; but the sheath is probably not as loose as in others. It corresponds, therefore, with my var. *brevispina*, Synops. Cact. in Proc. Amer. Acad. Arts and Sci., Vol. III. In delicate specimens — and such are usually the cultivated ones — the spines of most of the cylindric *Opuntiæ* do not exhibit the sheath very plainly; it usually adheres closely to the body of the spine. This vagina consists, like the whole spine, of elongated indurated cells; the barbs of the spine are covered by it and are closely adpressed until the vagina detaches itself, which commonly takes place very early.

Mr. Paulus Rœtter, of St. Louis, made the drawings for the plates under the close superintendence of the author. The steel engravings were done partly by Mr. W. H. Dougal, of Georgetown, D. C.; a few by Messrs. Maillard & Connor, of St. Louis; and the balance by European artists, namely, — Mr. Weber, of Berlin, Prussia, and Mr. Davesne, [78] Mr. Rebuffet, Mr. Martin Schmelz, and the brothers Picart, all of Paris, France. The high order of excellence of the engravings, especially of those of the Picarts and of Schmelz, cannot fail to strike those who examine the plates.

In the figures of the embryos in Plates XXIV., XXXIV., XLI., and XLVII., the line indicating the division of the cotyledons does not show in all the copies. The embryo in Plates XXIV. and XXXIV. resembles that of Plate LXXIV. figs. 9 and 10; and that of Plates XLI. and XLVII. is like that on Plate LV.

St. Louis, November, 1858.

EXPLANATION OF PLATES.

Remarks. — All the figures are in natural size unless otherwise stated. The seeds of Mamillariæ, Echinocacti, and [63] Cerei are represented in the natural size, and eight times magnified: *a* is a lateral view, natural size; *b*, same, eight times magnified; *c*, part of the surface of the seed still more magnified; *d*, seed after the removal of the outer coat, with endopleura and albumen; *e*, embryo; *f*, another form of same seed; *g*, seedling plant; *h*, back view; *i*, front view; *k*, basal view; *l*, top view of embryo. All eight times magnified.

The seeds of Opuntiæ, being larger, are represented: *a*, side view, natural size; *b*, same, four times magnified, as are all the following ones; *c*, posterior view; *d*, anterior view; *e*, vertical section; *f*, seed after the removal of the testa; *g*, embryo.

The landscape opposite the titlepage represents a region near the Colorado River, with several *Cacti*, especially *Cereus giganteus;* one of them decayed, showing the form of the ligneous skeleton. The different plants are accurate copies of nature.

Plate I. Mamillaria micromeris: 1, a young plant not yet blooming, without the tuft; 2, a plant in bloom, with the tuft; 3 and 4, different views of a plant of the largest size, — several fruits are seen in the tuft; 5, a tubercle with a bunch of spines, eight times magnified; 6, a bunch of spines in natural size, and 7, the same, eight times enlarged.

Plate II. *The same:* 1, lateral view of a bunch of spines, and its wool on the flower-bearing part of the plant, eight times magnified, exhibiting the upper elongated clavate spines; 2, flower, four times enlarged; 3, fruit; 4, seed. — Fig. 5–8. M. micromeris, var. Greggii: 5, bunch of spines; 6, same, eight times magnified, showing the ragged ends of the long spines where they are broken off; 7, a bunch of spines, with its wool from the flowering part of the plant, with the long clavate spines, eight times magnified; 8, seed.

Plate III. M. lasiacantha: 1, a plant of the ordinary size in flower; 2, flower, four times magnified; 3, a tubercle with a bunch of spines, showing the pubescence, eight times magnified; 4–5, bunches of spines, natural size, and eight times magnified.

Plate IV. M. lasiacantha, var. denudata: 1, a fruit-bearing plant; 2, a tubercle, with its bunch of spines, eight times magnified; 3–4, bunches of spines in natural size, and the same eight times magnified; 5, seed.

Plate V. M. pusilla, var. Texana: 1, whole plant in flower; 2, a tubercle, with a bunch of spines and the axillary wool, twice magnified; 3, a bunch of spines, same; 4, flower, same; 5, fruit natural size; 6, seed.

Plate VI., fig. 1–8. M. Grahami: 1, a single plant; 2–4, bunches of spines, with one, two, and three central [64] spines; 5, a tubercle and bunch of spines, magnified twice; 6, a bunch of spines from Dr. Parry's specimen from the Colorado, also magnified twice; 7, a flower from A. Schott's specimen from the Gila; 8, seed. — Fig. 9–12. M. barbata: 9, a tubercle and bunch of spines, natural size; 10, bunch of spines, magnified twice; 11, fruit; 12, seed.

Plate VII. M. phellosperma: 1, a flowerless plant; 2, a bunch of spines; 3, a tubercle with the axillary wool and bristles, and the terminal bunch of spines, twice magnified; 4–6, bunches of spines, with one or more hooks, twice the natural size; 7–8, fruits of different size; 9, seed.

Plate VIII., fig. 1–8. M. Wrightii: 1, a whole plant in fruit, from a sketch of Mr. Moellhausen's; 2, a young, and, 3, an old tubercle, with spines, of the same specimen; 4–6, spines of a specimen from the Copper-mines, four from the older part of the plant; 7, flower; 8, seed. — Fig. 9–14. M. Goodridgii: 9, tubercle with spines; 10, bunch of spines, natural size; 11–12, tubercles with the axillary wool and bristles, and the spines; 13–14, bunches of spines. The last four figures are magnified twice.

Plate IX., fig. 1–3. M. meiacantha: 1, whole plant in flower; 2, fruit; 3, seed. — Fig. 4–14. M. Heyderi, var.

APPLANATA: 4, upper part of plant in flower and fruit; 5–6, different views of flowers; 7, fruit; 8, seed, — all from the same specimen from El Paso; 9–14, bunches of spines of different forms of the same variety, from western Texas. — Fig. 15–17: bunches of spines and seed of the var. HEMISPHÆRICA, from Matamoras. — Fig. 18–20. M. GUMMIFERA: different views of tubercles and spines.

Plate X. M. ECHINUS: 1, whole plant in fruit; 2–3, tubercles showing the groove and the wool on the basal areola; 4–7, bunches of spines of younger and older plants; 8–9, same, with the central spine curved; 10, fruit; 11, seed.

Plate XI. M. PECTINATA: 1, whole plant in flower; 2–3, different views of tubercles from the sides of the plant; 4–7, bunches of spines; 8–9, tubercles from the flower-bearing top of larger plants; 10, seed.

Plate XII., fig. 1–16. M. TUBERCULOSA: 1, a large specimen in fruit; 2–11, tubercles and bunches of spines of different specimens (2–3, from a young plant; 10, a very young tubercle), — all the tubercles exhibit the large mass of dense wool at base; 12, flower-bud; 13, flower; 14, fruit; 15, seed of the same; 16, seed of another specimen, smaller, and with smaller marks. — Fig. 17–22. M. DASYACANTHA: 17–20, tubercles and bunches of spines of different specimens; 21–22, seeds of the same.

Plate XIII. M. RADIOSA, var. NEO MEXICANA: 1, a plant with several branches in flower; 2 and 3, different tubercles with bunches of spines, the woolly grooves extending more or less down along the upper side of the tubercle; 4, a bunch of spines; 6, a fruit; 7, seed.

Plate XIV. M. MACROMERIS in flower.

Plate XV. *The same:* 1, one of the largest bunches of spines; 2, one of the smallest ones; 3, a young tubercle not fully developed; 4, a young but full-grown tubercle, bearing the flower at the lower end of the woolly groove, far above the axil, a younger tubercle attached to it; 5, a ripe fruit, with a few scales; 6 and 7, seeds of the largest and the smallest kind.

Plate XVI. M. FISSURATA: 1, a flowering plant; 2, petals; 3–9 tubercles of different size and age and in different positions; 3, a large tubercle from above; 4, same from below; 5, same from the side; 6, a smaller one, with fewer divisions from above; 7, side view of same; 8, a small tubercle from above; 9, a young one, with the silky wool yet [65] straight and smooth; 10, a young tubercle bearing a fruit, which becomes visible after separating the wool; 11, seed.

Plate XVII. ECHINOCACTUS SCHEERII: 1, a full-grown plant in flower; 2, part of a rib, front view, showing the form of the tubercles and their grooves; 3, part of a rib, side view; 4–6, bunches of spines; 7, seed.

Plate XVIII. E. BREVIHAMATUS: a full-grown plant of ordinary size.

Plate XIX. *The same:* 1, part of a rib, side view, to exhibit the tubercles and their grooves; 2, part of a rib almost in front, with a flower; 3, a tubercle, with a flower at the base of the long groove; 4, a young bunch of spines from a small specimen; 5–8, bunches of spines from different full-grown specimens.

Plate XX. E. SETISPINUS: 1, top of a plant with flower; 2, another flower; 3, flower-bud; 4–6, bunches with 12 radial and 1 central spines of different size and shape; 7–9, bunches with more radial and sometimes more central spines; 10, bunch of spines, with two almost straight central spines; 11, fruit; 12, several seeds attached to the funiculi, four times magnified; 13, seed of the usual size and form; 14, larger seed of a specimen from Eagle Pass, to which spines fig. 8 belong.

Plate XXI. E. LONGEHAMATUS: part of a rib, with a flower.

Plate XXII. *The same:* a rib, side view, showing the tubercles, and with their short grooves and their flexuous spines.

Plate XXIII. *The same:* 1, a bunch of spines of the longest spined variety; 2, a fruit; 3, seed; 4 and 5, bunches of spines of the smaller variety.

Plate XXIV. *The same:* 1, a bunch of spines of the thick spined Mexican form; 2 and 3, lower central spines of the same; 4, seed of the *Limas agrias*, the sour cactus-berries of Saltillo, to exhibit the peculiar form of the seed and the great favosity of the surface.

Plate XXV. E. WISLIZENI: 1, upper part of a rib with a flower and a flower-bud; 2, pistil; 3, fruit; 4 and 5, seeds of different form and surface, from El Paso; 6, seed of different shape, from the upper Gila.

Plate XXVI. *The same:* 1–3, bunches of spines of different shape and proportion.

Plate XXVII. E. LE CONTEI: 1, part of a rib with a fruit; 2, a bunch of spines; 3, a flower; 4, section of same; 5, seed.

Plate XXVIII. E. EMORYI: 1, bunch of spines of a large specimen, from Guaymas; 2, young bunch of spines with flower, from Sonora; 3, section of flower.

Plate XXIX. E. VIRIDESCENS: 1 and 2, bunches of spines of a young plant; 3, flower; 4, pistil; 5, fruit, not fully ripe, and therefore a little shrivelled; 6, seed.

Plate XXX. E. CYLINDRACEUS: 1, a bunch of spines of a young specimen; 2–5, bunches of spines of older but not yet fully grown specimens.

Plate XXXI. E. HORIZONTHALONIUS: in flower.

Plate XXXII., fig. 1–5. *The same:* 1, a young plant; 2–4, spines of different forms; 5, seed. — Fig. 6–7. E. PARRYI: bunches of spines.

Plate XXXIII., fig. 1–6. E. TEXENSIS: 1, a larger, 2, a smaller bunch of spines; 3, flower; 4, fruit; 5, seed from Texas; 6, seed from Matamoras, smaller and more distinctly marked than fig. 5. — Fig. 7, seed of E. SANDILLON (Gay), from Chili, which has also a woolly fruit.

Plate XXXIV. E. INTERTEXTUS: 1, a plant of rather large size, in flower; 2–5, young bunches of spines, more [66] or less developed; 6–8, old bunches of spines; 9, fruit, with a few scales, with wool at base and the dry flower on top; 10, seed.

Plate XXXV., fig. 1–5. E. INTERTEXTUS, var. DASYACANTHUS: 1, 1–2, young bunches of spines; 3–5, old ones. — Fig. 6–8. E. UNGUISPINUS: bunches of spines.

Plate XXXVI. CEREUS VIRIDIFLORUS: 1, large plant, from the Limpia, in flower, one flower fully, another one half open; 2, bunch of spines of this plant without, and, 3, with a central spine; 4–7, bunches of spines of a specimen collected by Dr. Bigelow on the upper Pecos, with one or more central spines (4, a very young bunch; 5, a full-grown one; 6, a similar larger one, like the former, with two central spines; 7, another one, with the largest central spine curved upward); 8–10, bunches of spines with and without a central spine, from plants collected by Dr. Wislizenus in northeastern New Mexico; 11, part of a plant in flower, with very obtuse petals and very small spines, collected by A. Fendler at Santa Fé; 12–13, bunches of spines of this variety; 14, fruit from Santa Fé; 15, seed of the same; 16, fruit from the Limpia.

Plate XXXVII. C. CHLORANTHUS: in full bloom.

Plate XXXVIII. *The same:* 1, top view, exhibiting the rays formed by the central spines; 2–7, different bunches of spines; 8, a small fruit; 9, one of usual size; 10, seed of common size; 11, smaller seed.

Plate XXXIX. C. DASYACANTHUS: a simple, branchless plant, with one flower.

Plate XL. *The same:* bunches of spines, different in size, number, and proportion of the spines; all twice magnified.

Plate XLI., fig. 1–2. *The same:* 1, fruit; 2, seed. — Fig. 3–5. C. RŒTTERI: 3–4, bunches of spines, magnified twice; 5, a fruit.

Plate XLII. C. CTENOIDES: 1, a large specimen in flower; 2–3, front view and lateral view of a bundle of spines, twice magnified; 4, top part of another specimen, in which the spines are not so closely pectinate; 5–6, spines of this specimen, twice magnified.

Plate XLIII. C. CÆSPITOSUS: a specimen of one of the largest forms; petals unusually curled.

Plate XLIV. *The same:* 1–4, spines of the larger form, in different states of development, magnified twice; 5–7, spines of the smaller form, also magnified twice, — some of the bunches show rudiments of central spines; 8, a fruit with the rudiments of the flower shrivelled up; 9, a fruit exhibiting yet the tube of the flower very distinctly; 10–11, seed of the larger, and, 12, seed of the smaller form; 11, *g*, young seedling soon after germination.

Plate XLV. C. LONGISETUS.

Plate XLVI. C. STRAMINEUS: One head out of a plant with numerous heads.

Plate XLVII. *The same:* 1, another head with smaller spines, seen from above; 2–4, bunches of spines; 5, fruit; 6, seed of the same, usual size; 7, seed of another specimen larger than usual.

Plate XLVIII., fig. 1. A flower of the same. — Fig. 2–4. C. ENNEACANTHUS: 2, part of a stem showing the ribs and spines and a flower from El Paso; 3, flower of a specimen from Eagle Pass; 4, bunch of spines from El Paso, which, however, may belong to a form of *C. stramineus*, — lower central spine triangular and much flattened.

Plate XLIX. *The same:* 1, head of a specimen from Eagle Pass; 2, another one with longer and stouter spines; 3–10, bunches of spines of plants collected at Eagle Pass and at El Paso; 10, with a curved central spine; 11, fruit belonging to flower, fig. 3, of last page; 12, seed of same.

Plate L. C. DUBIUS: 1, part of a rib with a flower; 2, bunch of spines, and, 3, seed of same plant; 4–5, bunches [67] of spines of another specimen; 6, same, with flower just closed; 7, fruit, and, 8 seed of same.

Plate LI. C. FENDLERI: a vigorous head of a plant, brought from El Paso.

Plate LII. *The same:* 1, top of a plant with flower-bud and flower, from El Paso; 2, fruit with few and stouter spines; 3, seed of same; 4, fruit with numerous slender spines; 5, seed of same; 6, another form of seed.

Plate LIII. *The same:* 1, flower, from Santa Fé; 2, young bunch of spines; 3–12, bunches of spines of different shape and size.

Plate LIV. C. POLYACANTHUS: in flower; usual form with short spines.

Plate LV. *The same:* 1, part of a rib with a flower and a bud; 2–4, bunches of spines; 5, fruit with a bunch of spines; 6, seed of same; 7, fruit of another long-spined form; 8, seed of same.

Plate LVI. C. PAUCISPINUS: 1, an entire plant; 2–5, bunches of spines; 6, seed.

Plate LVII. C. ENGELMANNI: 1, a head, brought from Sonora by A. Schott; 2, young, and 3–4, older bunches of spines of the same; 5, fruit; 6, seed of same; 7, seed of Dr. Parry's original specimen.

Plate LVIII. C. BERLANDIERI: 1, part of a plant with flower and flower-bud; 2–4, bunches of spines; 5, fruit; 6, seed.

Plate LIX., fig. 1–11. C. PROCUMBENS: 1, a plant with flower-bud, flowers, and young fruit; 2–9, different bunches of spines; 10, fruit; 11, seed. — Fig. 12. C. TUBEROSUS: seed.

Plate LX., fig. 1–4. C. EMORYI: 1, a fruit; 2, a bunch of spines of this fruit; 3, another one twice the natural size; 4, seed. — Fig. 5–6. C. VARIABILIS: 5, fruit; 6, seed.

Plate LXI. C. GIGANTEUS: 1, part of the rib of an adult plant with two bunches of spines; 2, a bunch of spines; 3, part of a young rib of an adult plant collected in March, spines very short and slender yet; 4–5, bunches of spines of a young plant about 8 inches high.

Plate LXII. *The same:* 1, flower; 2, fruit; 3, seed; *m*, side view of embryo, cotyledons a little open; *n*, front view of same.

Plate LXIII. C. GREGGII, *a.* CISMONTANUS: 1, a flower; 2, a young plant raised from seed in the third year, showing the tuberous root.

Plate LXIV. *The same:* 1, lower part of a stem with the large tuberous root, half the natural size; 2–4, sections of the stem; 5–11, spines of different states of development and of different ages, all four times the natural size (5, a bunch of very young spines imbedded in the wool of the areola; 6–10, full-grown spines, — 10, shows the lower spines crossed; 11, represents a very old bunch of spines); 12, a fruit; 13, seed.

Plate LXV. C. GREGGII, *β.* TRANSMONTANUS: 1, flower; 2–3, spines. Four times magnified.

Plate LXVI. OPUNTIA STENOPETALA: 1, part of a joint; 2, part of another one with two flowers; 3, section of flower.

Plate LXVII. O. STRIGIL: 1, an elongated joint with two fruits, bearing a young joint; 2, an orbicular joint; 3, several seeds.

Plate LXVIII. O. FILIPENDULA: 1, a whole plant in flower, half natural size; 2, a joint with flower and young fruit, natural size; 3, seed of this plant from below El Paso; 4, seed of same from Doña Ana, above El Paso, a little smaller.

Plate LXIX. O. MACRORHIZA: 1, a whole plant with flower and buds, half natural size; 2, fruit, natural size; [68] 3–4, seeds of different size.

Plate LXX. O. EMORYI: from the region southwest of El Paso, in fruit.

Plate LXXI. *The same:* 1, a whole plant, reduced; 2, lateral view of a tubercle with a bunch of spines; 3, front view of one of the largest bunches of spines; part of the central spine, four times magnified; 4, different seeds.

Plate LXXII. O. GRAHAMI: 1, whole plant, with large tuberous roots, and in fruit; 2, a young joint; 3, a bunch of spines of the usual form; 4, another one with broader central spines; 5, seed. The seed, as well as parts of spines, are four times magnified.

Plate LXXIII., fig. 1–3. O. SCHOTTII: 1–2, bunches of spines, with parts four times magnified; 3, seed with an oblique embryo. — Fig. 4. O. SCHOTTII, var. GREGGII: a bunch of spines, with part magnified four times. — Fig. 5–6. O. BULBISPINA: 5, an entire joint; 6, a bunch of spines, part of central spine four times magnified. — Fig. 7–8. O. IMBRICATA: 7, a joint; 8, a bunch of spines, and fragment of central spine, four times the natural size, showing the sheath.

Plate LXXIV. Seeds of, — 1, *Mamillaria calcarata;* 2, *M. compacta;* 3, *M. vivipara;* 4, *M. radiosa,* var. *borealis;* 5, *M. radiosa,* var. *Texana;* 6, *M. Nuttallii, a. borealis;* 7, *β. cæspitosa;* 8, *M. robustispina;* 9, *Echinocactus uncinatus;* 10, *E. uncinatus,* var. *Wrightii;* 11–14, *E. sinuatus* (11, from the San Pedro, Wright; 12, from northern Mexico, Gregg; 13, from the same regions, Poselger; 14, the form sent by Poselger under the name of *E. robustus*); 15, *Cereus Thurberi;* 16, *C. Schottii.*

Plate LXXV. Seeds of OPUNTIA: 1–4, *O. Engelmanni* (1, from Chihuahua, Wislizenus; 2, from Matamoras; 3, from Presidio, Bigelow; 4, from Santa Rosa, Bigelow); 5–7, *O. dulcis,* Wright and Bigelow; 8, *O. macrocentra,* Wright; 9–13, *O. phæacantha* (9, from Santa Fé, Fendler; 10–13, southern New Mexico, Wright); 14, *O. tenuispina,* El Paso; 15, *O. arenaria,* El Paso; 16–17, *O. arborescens;* 18, *O. fulgida;* 19, *O. mamillata.*

IX. CACTACEÆ OF THE IVES EXPLORATION.

FROM REPORT UPON THE COLORADO RIVER OF THE WEST, EXPLORED IN 1857 AND 1858, BY LIEUTENANT JOSEPH C. IVES. Washington, 1861. Part IV. BOTANY. P. 12–14.

MAMILLARIA GRAHAMI, Engelm. in Mex. Bound. Rep., II. p. 7, tab. 6, fig. 1–8; Synops. Cact. in Proc. [12] Amer. Acad. Arts and Sci., III. p. 6. Common along the Colorado. In flower April 7; fruit of last year just ripe. In the Mex. Bound. Rep. the fruit is erroneously called a "small oval berry, probably green." The specimens then at command had shrivelled and discolored fruit; those now before me show that the berry is elongated, clavate, scarlet, ¾ or even 1 inch long, with or without the remains of the flower. The seeds are absolutely the same as those of the El Paso plant.

MAMILLARIA PHELLOSPERMA, Engelm. l. c., p. 6, tab. 7; Synops. Cact., p. 6. Common with the last, and easily confounded with it by the casual observer; apparently more abundant westward, while the former prevails more eastward. Generally simple, sometimes many-headed. Some of Dr. Newberry's specimens closely resemble the figure in Mex. Bound. Rep.; others have fewer (30–35), shorter, and stiffer spines, almost in 3 series, the 8–12 interior ones stout and purplish-brown. One of the specimens before me has in each bunch three divergent, hooked, central spines.

ECHINOCACTUS WHIPPLEI, Engelm. & Bigelow in Pacif. Rail. Rep. IV., Cactaceæ of Lieut. Whipple's Exped., p. 28, tab. 1; Synops. Cact., p. 15. In sandy soil on the Little Colorado, often half buried in sand, in the same region where Dr. Bigelow discovered this pretty species in 1853. In flower in the middle of May.

The specimens have 13 compressed, interrupted ribs. The floriferous is contiguous to the spiniferous [13] areola, not separated from it by the cylindric glands present in several allied species. After flowering, the floriferous areola forms a groove two thirds down the upper side of the tubercle (or prominent part of the rib), or even almost to its base. Number of radial spines 7 to 11. The description of the flower, wanting heretofore, may be given thus: —

Floribus versus apicem congestis virescenti-flavis pollicaribus; ovaris sepalis squamiformibus paucis (2–5) orbiculatis seu reniformibus munito; sepalis tubi 10–15 inferioribus ovatis, superioribus oblongis obtusis; petalis sub-8 oblongis mucronatis; infimo tubi parte intus nudo; filamentis tenuissimis numerosis; stylo exerto sursum clavato apice infundibuliformi in stigmata 5 brevissima erecta seu conniventia diviso.

The flowers are 1 inch long, greenish-red, externally tinged with brown-red; stigma green. The fruit remains unknown as yet. The large seed has been figured in the work mentioned.

Echinocactus Lecontei, Engelm. in Mex. Bound. Rep., II. p. 23, tab. 27; and Pacif. Rail. Rep. l. c., p. 28, tab. 2, fig. 3–5; Synops. Cact., p. 18. In the Colorado valley. In flower in April. — Specimens of 3–5 inches diameter have below 8 and above 13 ribs; those of 9–12 inches show 19–21 ribs. The lowest bunches (those developed probably in the third or fourth year) have 8 radial and 1 central spines, all annulated; the central one is curved, not hooked, 1 or even 3 of the lower radial ones are often hooked. The fully developed bunches consist of 4 central spines, the upper and lower one of which is quite flat; 5 or 7 lower radial ones, never hooked; 3 upper ones; and 6–12 slender, bristly radial spines. The ovary is covered with about 30 sepaloid scales, in the specimens examined, in $\frac{4}{11}$ or $\frac{5}{13}$ arrangement.

Echinocactus? Young specimens, 3–5 inches high, of another evidently large species, were collected, with 13 ribs; 4 central and 5 lower, stouter, and 3–6 upper slender radial spines, all annulated and curved. The plants, showing no indication of floriferous areolæ, must be undeveloped; they may possibly be young ones of *E. polycephalus*, or belong to species yet unknown to us.

E. viridescens, Nutt. in Torr. & Gray, Fl. I., p. 554; Engelm. in Mex. Bound. Rep. II., p. 24, tab. 29; Synops. Cact., p. 19. San Diego, California; with 25–30 scales on yellow fruit. Seed as described in Mex. Bound. Rep., but the pits are much closer together than in fig. 6, c.! The hooked acute cotyledons are bent over a rather copious albumen, similar to those of *E. Wislizeni*, tab. 25, fig. 4, e.

Cereus Fendleri, Engelm. in Plant. Fendl. in Mem. Amer. Acad. 1848, p. 51; Mex. Bound. Rep. II., p. 33, tab. 51–53; Synops. Cact., p. 25. Coveras, New Mexico, and from Laguna to Santa Fé. Flowers in April.

C. phœniceus, Engelm., Pacif. Rail. Rep. l. c., p. 34, tab. 4, fig. 1; Synops. Cact., p. 28. *Echinocereus coccineus*, Engelm. in Wisliz. Rep. N. Mex., note 9. — This is *Mamillaria aggregata*, Emory's Report, 1848, and the "Aggregated Cactus" of the explorers of the western parts of New Mexico and the Gila regions. It grows in large dense masses, often 100 or 200 heads from a single base, the whole often of the shape and size of a bushel basket, generally on apparently naked rocks; in the proper season densely covered with beautiful crimson flowers. It was found from Camp 64 to Camp 78 (Yampai Valley to Partridge Creek). In flower in April. The flowers collected are less than 2 inches long, much more densely covered with bristle-bearing sepals than the next species, and with only 5 stigmata; the naked space in the base of the tube is nearly 4 lines long. The fruit and seed of this common plant, which has now been known to science for twelve years, still remains unknown, and living plants are as yet extremely scarce.

C. conoideus, Engelm. & Bigelow, l. c., p. 35, tab. 4, fig. 4–5: Synops. Cact., p. 28. Camp 96 (Oryabe gardens, Moqui country) Flowering in May. — So nearly allied to the last that we considered it a [14] form or subspecies of it. Dr. Newberry has now obtained the flowers. His specimen has fewer spines than Dr. Bigelow's original ones, — 8 or 9 radial ones, about 1 inch long, and 1 or 2 central angulate ones, 1½–2 inches long, all whitish and somewhat translucent. They resemble the spines of *C. enneacanthus;* but the flowers are vastly different, being open day and night, and not diurnal, as those of the species just mentioned.

Floribus magnis diametro transversali duplo longioribus coccineis; ovario parvo squamis sepaloideis 8–12 triangulatis in axilla lanam albam et aculeolos 3–5 graciles gerentibus munito; tubo sensim ampliato sepalis fere 20 lanceolatis aculeigeris instructo; sepalis superioribus sub-8 oblongis obtusis; petalis 10–13 spathulatis obtusis; staminibus numerosissimis et stigmatibus sub-9 vix exsertis petala subæquantibus.

The flowers are 3½–4 inches long and 1½–2 inches in diameter; the slender spines in the axils of the upper sepals are 6–8 lines in length; the stigmas, as in the whole subgenus *Echinocereus*, velvety green.

Opuntia basilaris, Engelm. & Bigelow, l. c., p. 43, tab. 13, fig. 1–5, and tab. 23, fig. 14; Synops. Cact., p. 42. Abundant on the Colorado from Fort Yuma to the Great Cañon, and one of the most common species in the Colorado valley and desert. Dr. Newberry confirms the description before given of the peculiar growth of this species. A large number of joints of different shape — obovate, obcordate, emarginate, or elongate and almost oblanceolate — issue from

nearly the same base, and are covered in spring (March and April) with a profusion of rose-colored or purplish flowers, often 150 on one plant. The ovary is described as somewhat tuberculate, but sometimes almost smooth. The fruit is dry when ripe. Seed large and thick, as in the figure above cited.

O. HYSTRICINA, Engelm. and Bigelow, l. c., p. 54, tab. 15, fig. 5–7, and tab. 23, p. 15; Synops. Cact., p. 43. Common from the Colorado to the Rio Grande. The form collected by Dr. Newberry, and named in his notes "hairy-spined Opuntia," has fewer, shorter, and usually straighter spines than the specimens figured and described in Lieutenant Whipple's Report; the larger ones are also angular and erect, and by these characters distinguished from the nearly allied *Opuntia Missouriensis*. However, Mr. Fendler's specimens from Santa Fé (the flowers of which were inadvertently distributed with No. 276, *O. phæacantha*, but are easily distinguished by the spinulose ovary) seem to be intermediate between the two, and may make it necessary to unite them.

Dr. Newberry's specimens have 1–5 larger spines, 1–1¾ inch long, nearly erect, and about 5 smaller deflexed ones below, with a few very small ones above. Flower nearly 2 inches in diameter; ovary with 20–25 tomentose pulvilli, each with a short slender leaf (sepal) less than 1 line long, and 5–12 bristly spines of very different lengths; the interior sepals are obovate cuspidate petals, obcordate, orange-yellow; 5 erect green stigmata, forming a compact head.

O. ECHINOCARPA, Engelm. & Bigelow, l. c., p. 40, tab. 18, fig. 5–10, and tab. 24, fig. 8; Mex. Bound. Rep. II., p. 56; Synops. Cact., p. 49. In the Mojave valley, and common on the Colorado. Begins to flower the end of March. The specimens obtained are low, with many short branches, much of the habit of the clavate *Opuntiæ*, but distinguished from them by the sheathed spines and the reticulated wood peculiar to the cylindroid *Opuntiæ*. The ovary is 6–8 lines long, with about 20 pulvilli, bearing thick ovate leaves, abruptly narrowed into a subulate point, 1–2 lines long, and in their axils in a white tomentum 6 or 8 sheathed spines, the large ones 6–8 lines long. The greenish-yellow flower when fully open is 1½ inch wide; petals spatulate, rounded or emarginate, denticulate, the exterior ones mucronate; stigmata 5–6, large and thick, and apparently yellow.

O. ARBORESCENS, Engelm. in Wisliz. Rep. N. Mex., note 5; Mex. Bound. Rep. II., p. 58, tab. 75, fig. 16–17; Pacif. Rail. Rep. IV., tab. 17, fig. 5–6, tab. 18, fig. 4, and tab. 24, fig. 12; Synops. Cact., p. 51. Common in western New Mexico.

X. ADDITIONS TO THE CACTUS-FLORA OF THE TERRITORY OF THE UNITED STATES.

FROM THE TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS, Vol. II.

SINCE my "Synopsis of the Cactaceæ of the United States"[1] was published, Dr. J. S. [197] Newberry, attached to Lieutenant Ives's Expedition to the Colorado River, 1857–58, has elucidated more fully the natural history of several species heretofore only imperfectly known.[2] In the same year (1858) and the following one my brother, Henry Engelmann, geologist to the Expedition sent under Captain James H. Simpson, U. S. Topographical Engineer, to explore the best emigrant routes through the interior of Utah, discovered in that interesting country a number of new forms, which were placed in my hands for examination. My report on them, illustrated by several plates from the hands of our skilful artist, Mr. P. Rœtter, was in due time sent to the Department; but the necessities of the country not permitting the official publication, I have received permission to communicate the substance of my investigations.

1. MAMILLARIA VIVIPARA, Haw. Engelm. Synops. Cact., p. 13. In the South Pass, and on Sweetwater River; no specimens of this wide-spread species have turned up from the other side of the great mountain-chain.

2. ECHINOCACTUS SIMPSONI, sp. nov.: e basi turbinata simplex, subglobosus seu depressus, mamilliferus; tuberculis laxis ovatis oblique truncatis axilla nudis; areolis ovatis seu ovato-lanceolatis, nascentibus albo-villosissimis mox nudatis; aculeis exterioribus sub-20 tenuibus rigidis rectis albidis, interioribus 8–10 erecto-patulis robustioribus

[1] Proc. Amer. Acad. Arts and Sci., Vol. III. pp. 259–314, and 344–346, Nov. 1856.

[2] See my account in Lieutenant Ives's Colorado River Exploring Expedition; Botany, pp. 12–14. Washington, 1861.

paulo longioribus obscuris; areola florifera sub tuberculi apice aculeis contigua circulari; floribus in vertice dissitis minoribus; sepalis ovarii paucis et tubi brevis inferioribus orbiculatis crenulatis, superioribus ovatis obtusis, petalis oblongis cuspidatis e virescente roseis, stigmatibus 5–7 brevibus in capitulum globosum compactis; bacca parva sicca umbilico latissimo truncata flore marcescente demum deciduo coronata; seminibus paucis magnis oblique obovatis minute tuberculatis.

Var. β. MINOR: tota planta, tuberculis, aculeis, seminibusque minoribus.

Butte Valley, in the Utah desert, and Kobe Valley, farther west; var. β. in Colorado Territory, *e. g.* in coarse gravel or in crevices of rocks, abundant near Mount Vernon, at the base of the mountains (Parry, Hall, & Harbour). Flowers in May; fruit in July and August. — With the New Mexican *E. papyracanthus*,[3] the Mexican [198] *E. horripilus*, Lem., and perhaps the South American *E. Odierii*, Lem., and *E. Cummingii*, Salm, this species forms a small section of Echinocacti with the appearance of Mamillariæ, named by Prince Salm (Hort. Dyck, 1849, p. 34) *Theloidei*. Through the *Coryphanthæ* they are nearly allied to Mamillaria; while our species at least (the fructification of the others not being known), by its dry fruit, its black tuberculated seeds, and especially the large and curved embryo and the presence of an albumen, proves itself a true Echinocactus, very closely connected with the regularly ribbed *E. intertextus*, Engelm. Cact. Mex. Bound., tab. 34. The similarity in all essential organs of these two species is such that no system ought to separate them; proving again of how little essential importance among Cactaceæ the external form must be regarded. Another striking example, among many, is the rat-tail *Cereus tuberosus*, and its globular or oval allies, *C. cæspitosus*, etc.

Full-grown specimens are 3–5 inches high and 3–4 inches in diameter; dark green tubercles, loosely arranged in $\frac{8}{21}$ or $\frac{13}{34}$ order, 8 and 13 spirals being most prominent; tubercles 6–8 lines long, at base 6–7 lines wide in the vertical and 4–5 lines in the transverse diameter, fruit-bearing ones rather shorter and stouter; areolæ 3–4 lines long. External spines 4–6 lines long, whitish, with the addition of several bristles at the upper end of the areola; central spines 5–7 lines long, yellow, reddish, deep brown or even black upward. Flowers 8–10 lines long and of nearly the same diameter, with a short and wide tube, externally greenish-purple; petals yellowish-green verging to pale purple; the short stamens arise from the whole inner surface of the tube, leaving only a very small nectariferous space in its base; funiculus very short, stout and straight, and not curved over the micropyle, as I have found it in almost all other cactus flowers examined. Fruit 3–3½ lines long, about the same in width, with 1–3 small calycine scales toward its flat top, each with 1 or 2 small spines in its axil; it usually bursts irregularly on the side, and, falling off, leaves its base adhering to the areola, as is the case in other dry-fruited Echinocacti, e. g. *E. horizonthalonius*. Seeds 1½ line long in the longest diameter, covered with minute, closely set tubercles, with a large oval subbasilar hilum, and an embryo strongly curved around a small albumen. The plant germinates with erect pointed cotyledons, and [199] when a few weeks old begins to develop its then pubescent spines.

Var. β., with smaller tubercles in $\frac{8}{21}$ or $\frac{13}{34}$, or even $\frac{21}{54}$ order, closely set, bearing smaller but often more numerous spines (20–28 external, 6–7 internal), may be confounded with the simple mountain form of *M. vivipara*, from which, when not in flower or fruit, only a close examination can distinguish it.

3. ECHINOCACTUS PUBISPINUS, sp. nov.: parvus, turbinatus; costis 13 subobliquis compressis interruptis; areolis orbiculatis; aculeis breviusculis velutinis demum nudatis albidis apice adustis, radialibus inferioribus lateralibusque 5–8 brevioribus, superioribus 1–2 robustioribus rectis curvatis seu hamatis, centrali deficiente seu singulo robustiore longiore arrecto sursum hamato.

Pleasant Valley, near Salt Lake Desert. Found in May without flower or fruit, but exhibiting in the vestiges of the small supraspiral floriferous areolæ the character of the genus. — Perhaps the smallest species of the genus, 2 inches high, 1–1¼ in diameter; ribs formed by compressed confluent tubercles; areolæ 4–6 lines apart. Radial spines 1–4 lines long, more densely pubescent or even tomentose than I have seen them in any other Cactus, on the lower areolæ 5 or 6, on the upper ones 9–12; here and there a single central spine makes its appearance, 5–6 lines long, stouter, and always strongly hooked.

4. E. WHIPPLEI, Engelm. & Bigelow, Cact. Whipp., p. 28, tab. 1; Synops. Cact., p. 15; Ives's Exped. Bot., p. 12. Var. SPINOSIOR: aculeis radialibus 9–11, inferioribus sæpe obscurioribus, reliquis longioribus niveis, summis 2 sæpe elongatis latioribus curvatis, centralibus 4, summo longo plano flexuoso, cæteris paulo brevioribus obscuris, solo infimo seu omnibus hamatis.

Desert Valley, west of Camp Floyd, Utah, with the remnants of flowers and fruit, and with seeds hid between the spines exactly like the seeds figured in the plate cited above. Embryo curved about ¾ around a large albumen;

[3] *Mamillaria papyracantha*, Engelm. Plant. Fendl., p. 49; Synops. Cact., p. 8. A closer examination of the dry specimen obtained by Mr. Fendler near Santa Fé proves that the floral areola joins the spiniferous one on the top of the small nascent tubercles, making the plant an *Echinocactus*, according to the views at present prevalent. It is singular that Fendler's single specimen has remained thus far the only one ever obtained of this well-marked species.

stigmas 6–7. The locality is about 5 degrees north of the place where Dr. Bigelow, and afterward Dr. Newberry found the plant.

5. CEREUS VIRIDIFLORUS, Engelm. Evidently the most northern Cereus, found as far north as the Laramie region, and not rare in Colorado, where it occurs 1–3 inches high, mostly with 13 ribs, and with the greatest variability in the color of the radial spines and in the presence of the 1–2 central ones.

6. C. ENGELMANNI, Parry. In the Salt Lake Desert, far to the northwest of the country where it was originally discovered. Always characterized by the cruciate central spines.

7. OPUNTIA SPHÆROCARPA, Engelm. & Bigelow. Var.? UTAHENSIS: diffusa; articulis orbiculato-obovatis crassis, junioribus sæpe globoso-obovatis vix tuberculatis; areolis subapproximatis; foliis minutis [200] subulatis divaricatis; setis brevissimis, aculeis nullis seu parvulis seu rarius singulo longiore recto robusto albido; floribus sulphureis; sepalis exterioribus transversis obcordatis cuspidatis; petalis 8 late obovatis emarginatis; stigmatibus 8 brevibus erectis; bacca obovata areolis sub-25 stipata; seminibus irregulariter compressis anguste marginatis.

In the Pass, west of Steptoe Valley, in the Utah basin. In flower and fruit at the end of July. — Joints 2–3 inches long and of nearly the same diameter; areolæ 6–8 lines apart; leaves smaller than in any other of our species except *O. basilaris*, scarcely 1 line long; bristles few on young, none on old joints, about ½ line long; stouter spines, when present, ¾–1 inch long. Flowers 3 inches in diameter, pale or sulphur-yellow. Fruit 1 inch long, half as thick, with a very deep umbilicus, and with a few bristles, or here and there a minute spine on the areolæ; in the specimens before me apparently fleshy, but perhaps dry at full maturity. Seeds very irregular, 2 lines or in the longest diameter 2½ lines wide.

Loth to increase the number of ill-defined species, I provisionally attach this to the New Mexican *O. sphærocarpa*, of which, however, leaves and flowers are as yet unknown, and the fruit is rather different.

8. O. HYSTRICINA, Engelm. & Bigelow, is evidently a western representative or may be a western form of *O. Missouriensis*. (See Bot., Ives's Exped., p. 14.) It was collected in the present Territory of Nevada, between Walker and Carson rivers. Flowers 2½–3 inches wide, larger than in Dr. Newberry's specimen; stigmas 8–10, short, erect.

9. O. MISSOURIENSIS, DC., itself is not rare in the deserts between Salt Lake Valley and Rush Valley. Var. ALBISPINA, approaching to var. *trichophora*, was found on Smith Creek, Lookout Mountains. Flower 3–3½ inches in diameter; ovary with 20 or 25 scarcely spiny areolæ; 5 very short erect stigmas.

10. O. FRAGILIS, Haw. Suppl., p. 82. *Cactus fragilis*, Nutt., Gen. I., p. 296. Fort Kearney to the North Platte country. In flower in June and July. — This, I believe, is the first time, since Nuttall's discovery in 1813, that the flowers of this species were collected. Travellers report the plant very common on the sterile prairies at the foot of the Rocky Mountains, but rarely found in flower, and still more rarely in fruit. It seems to propagate principally by the extremely brittle joints, which even the wind is apt to break off and carry about. I have had for many years specimens in cultivation, brought by Dr. Hayden, but have never been able to obtain flowers. Nuttall says the flowers are solitary and small, — in the specimen before me they are nearly 2 inches in diameter, pale [201] yellow; ovary 8–9 lines long, with 13–15 areolæ, densely covered with white wool, the upper ones with a few white spines; lower sepals broadly oval, with a short cusp; petals 5 obovate, roundish, crenulate; style longer than stamens; stigmas 5, short, cuspidate, erect.

11. O. PULCHELLA, sp. nov.: parvula, diffusa; articulis obovato-clavatis leviter tuberculatis; foliis minutis e basi ovata subulatis; areolis confertis, superioribus aculeos albidos rectos, singulum longiorem complanatum porrectum seu deflexum, cæteros brevissimos radiantes gerentibus; floris purpurei ovario areolis 13–15 albo-villosissimis et aculeoligeris dense stipato; sepalis inferioribus lineari-oblongis breviter cuspidatis, superioribus cuneato-spatulatis; petalis 8 obovatis obtusis; stylo cylindrico exserto, stigmatibus 5 linearibus suberectis.

Sandy deserts on Walker River, Nevada. Flowers in June. — This is one of the smallest and prettiest species of the genus, and belongs to the section *Clavatæ* (Synops. Cact., p. 46). It is readily distinguished from its allies by the small joints and purple flowers. Joints 1–1¼ inch long; leaves scarcely 1 line long. Flower bright purplish-red or deep rose-red, 1¼–1½ inch in diameter; ovary 4–5 lines long, beset with white bristly spines, 15–25 on each areola; style not ventricose in the lower half, as is usual in this genus;[4] stigmas slender, pale yellow.

[4] Another deviation from the usual form I observe in the style of *O. coccinellifera*. From a very narrow and short base it is suddenly dilated five or six times its diameter, and then gradually contracts upward.

From other sources I am enabled to give the following further Additions and Corrections to my former publications: —

Many *Eumamillariæ* (Synops. Cact., p. 4) have an *ovarium exsertum*. Not only do the large-flowered *Longimammæ*, which approach closely to Coryphantha, deviate in this respect from the assumed character of the subgenus, but in a great many other species I find the same peculiarity; so that I am inclined to restrict the *ovarium immersum* to that natural subdivision, the *Lactescentes*, already recognized by Zuccarini. Probably all those with limpid juice have an exsert ovary.

MAMILLARIA BARBATA, Engelm. This species is easily propagated by seed, and apt to flower in the second year. The first flowers in spring (May) appear in the axils of the last, innermost tubercles of the last year, and are therefore almost central; the later ones seem to be developed from the axils of the first tubercles of the same spring! Flowers 9–10 lines long, of the same diameter; tube constricted above the exsert oval ovary; 12–13 exterior green sepals, lanceolate, cuspidate, fimbriate, 8 interior ones, reddish, longer, lance-linear, slightly ciliate; 18–21 petals, rose-red, with a deeper colored streak, lance-linear, shorter and narrower than [202] the inner sepals, entire; stamens not half as long as petals, with oval anthers; style much longer than stamens, with 5–6 short, greenish-yellow suberect stigmas.

M. BICOLOR, Lehm., is not a Texan plant, as has been stated inadvertently in Synops., p. 7. Dr. Poselger found it on another Rio Grande, between Tampico and Real del Monte, Mexico.

M. PAPYRACANTHA, Engelm., is an Echinocactus, as stated above.

M. RECURVISPINA, Engelm. in Cact. Mex. Bound., p. 12; Synops., p. 10. As there is already a species named thus by Vriese (see Walp. Rep. 2, p. 301), I now name the Arizona species *M. recurvata*. *M. recurva*, Lehm., is a form of *M. macracantha*, DC., fide Salm.

CEREUS VARIABILIS — thus named in Cact. Mex. Bound., p. 40, tab. 60, fig. 5–6, and in Synops., p. 31 — is not Pfeiffer's plant, figured in Abbild. 2, tab. 15, but seems to be, as regards fruit and seeds, identical with a species obtained by Dr. Poselger near Tampico, and decided by him to be *C. princeps*, Hort. Würzb. ex-Pfeiff. Enum., p. 108. Plants from the Rio Grande have repeatedly bloomed here at the late Mr. Grieve's, and as the flower has never been described, I here supply the omission. Fruit and seed, obtained near Matamoras, have been described and figured in Mex. Bound. Cact. l. c.

Flores ad apicem caulis ramorumve pauci magni albi nocturni; ovario ovato areolis aculeolatis 25–30 stipato; tubo elongato cylindrico sursum sensim ampliato areolis 16–20 vix squamigeris inferioribus aculeolatis munito; sepalis superioribus 20–25 lanceolatis patulis reflexisve; petalis 40–50 pluriseriatis lineari-lanceolatis patentissimis; staminibus superiori tubi parti gradatim adnatis; stigmatibus 12–13 in capitulum clavato-obovatum coarctatis pallide virescentibus.

In bloom from July to September. Flower 7–8 inches long, 5½–6 inches wide; tube 4–5 inches long. Lower sepals near the well-defined upper edge of the tube reddish-green, 3–9 lines, upper ones petaloid, 9–18 lines long; petals 2 inches long and about 4 lines wide. Lower part of the tube, for 2 or 2½ inches, with a naked, nectariferous surface; the upper part, 2½–3 inches, densely beset with stamens of about equal length, so that the mass of the anthers form a deep funnel corresponding to the shape of the upper part of the tube. The outer series of stamens forms a regular crown, but is not separated from the inner lower ones by a naked belt, such as is found in many species; nor are the filaments declined and, so to say, fasciculated. This is interesting, as it weakens the value of this arrangement of stamens as a generic or subgeneric character; nevertheless, it is one of the few general characters left us [203] to be used in the arrangement of the very large number of species of this protean genus, to which several lately established genera have to be reduced. The following disposition is suggested: —

1. Cerei flore regulari plerumque breviore; staminibus tubo gradatim adnatis.

Echinocereus, Engelm.
Acanthocereus.
Lepidocereus, Engelm.
Pilocereus, Lem.

2. Cerei flore sæpe obliquo plerumque longiore; corona staminum exteriorum erectorum a cæteris gradatim adnatis plus minus declinatis discreta.

Echinopsis, Zucc.
Eucereus.
Phyllocactus, Link.
Disisocactus. Lindk.

Under the name Acanthocereus I comprise the species of this division with spiny fruit, but not belonging to Echinocereus; it is probable that Pfeiffera, Salm, is only a diminutive form of Acanthocereus. Lepidocereus — to

which many tropical species must be referred, and also a few which lately have been classed with Pilocereus — is distinguished from the latter by the uniformity of the fertile and sterile branches and areolæ; while in Pilocereus the fertile areolæ are closer together, and densely beset with bristly spines or long wool. Eucereus, in a more restricted sense than Miquel has used it in his Genera, or 9 in the Synopsis, would comprise the largest number of Cerei of the second division, of very different external shape, and would probably have to be again subdivided when we get to know more of the fructification of the different species. Neither Echinopsis nor Phyllocactus do in their flowers differ from Eucereus; and Disisocactus is but a depauperate Phyllocactus, with scarcely more than the crown of stamens left, a few single ones representing the great mass of inner stamens of the allied sections. I am as yet undecided whether Epiphyllum, as restricted by Prince Salm, has also to be united with Cereus or not. The fasciculated declined stamens spring from the whole tube; the exterior ones form no crown, but the innermost ones are separated from the rest, and form, with their confluent bases, a kind of vault, which is arched over the base of the tube. I have had no opportunity to examine fruit and seed.

I am not sure whether the true *Cereus variabilis* is also found on the lower Rio Grande. A specimen in Mr. Gœbel's horticultural establishment, said to come from that region, has repeatedly flowered and borne fruit. The flowers opened in May, and the fruit ripened after ten or eleven months. Flower 9 inches long, white, open only at night; ovary angular, with 5 or 6 triangular scales, but no spines; long tube with about 8 scales; [204] crown of exterior stamens distant from the others 8 or 9 lines; about 10 filiform spreading stigmas. Fruit irregularly oval, about 2 inches long, naked, deep violet-purple, at last bursting and dropping seeds and pulp. Seed quite different from that of the last species, very obliquely obovate, almost curved from a narrow base, with an orbicular hilum, 0.9 line long, smooth, shining, with a few irregular dots.

Through the kindness of Dr. A. W. Chapman, of Apalachicola, Florida, I have received living specimens and fruit of the little southeastern sea-coast Opuntia, so that I can now complete and correct the description of this very distinct species.

Opuntia Pes Corvi, Le Conte in herb; Engelm. App. to Synops. Cact. in Proc. Amer. Acad. Arts and Sci., III. p. 346; Chapm. South. Flora, p. 145: læte viridis, diffusa; articulis parvis ovatis seu obovatis tumidis sæpius teretiusculus fragilibus; pulvillis pulvinatis; foliis ovatis cuspidatis incurvis; areolis junioribus albo-tomentosis setas parcas brevissimas pallidas et plerisque aculeos 1–3 rectos rigidos sæpe basi compressos tortosque obscuros gerentibus, infimis inermibus; floribus minoribus flavis; ovario obovato pulvillis perpaucis fusco-villosis stipato; sepalis exterioribus ovato-lanceolatis, interioribus obovatis cuspidatis; petalis sub-5 obovatis spatulatis obtusis; stigmatibus 4–5 erectis; seminibus paucissimis anguste obtuseque marginatis in pulpa viscosa baccæ sæpe floris rudimentis coronatæ nidulantibus.

Barren sands along the coast of Georgia and Florida. — Joints 1–3 inches long, obovate, tumid, or narrower and subcylindric, usually many of them growing in the same season, one from the top of the last one, till they at last become prostrate and 1 or 2 feet long; pulvilli somewhat prominent, 4, 6, or even 8 lines apart; leaves $2\frac{1}{2}$–$3\frac{1}{2}$ lines long; spines 1–$1\frac{1}{2}$ inches long, very straight, when in threes divergent. Flowers $1\frac{1}{2}$–$1\frac{3}{4}$ inches in diameter; sepals and petals less numerous and narrower than in any allied species; ovary $\frac{1}{2}$ inch long, with only 2 or 3 areolæ on its surface and 3–5 on its upper edge. Fruit obovate, 6–7 lines long, rose-purple, with a shallow umbilicus; areolæ almost obliterated. Seeds 2 lines in diameter, 1–3, rarely as many as 5, in one fruit. Evidently near *O. vulgaris*, from which the shape and armature of the joints sufficiently distinguish it; far removed from *O. fragilis*, with which at first glance the tumidity and fragility of the joints would seem to connect it.

XI. CACTACEÆ OF CLARENCE KING'S EXPLORATION OF THE FORTIETH PARALLEL. Vol. V. Botany, by SERENO WATSON. P. 115–120. 1871.

Mamillaria (Eumamillaria) Grahami, Engelm. Globose or oval, usually simple, 1–3 inches high. [115] On the short, oval, close-set tubercles are numerous thin but rigid whitish spines, 3–6 lines long; the outer 15–30 in a single series and straight, surrounding a stouter and longer hooked brown one. Flowers small, nearly 1 inch wide, reddish; berry oval, green, with black pitted seeds. — Rocky localities in southern New Mexico, Arizona, and the adjoining parts of Utah.

M. phellosperma, Engelm. Resembling the last, rather larger, more oblong or cylindrical; tubercles longer and less crowded. Spines more numerous; the outer 40–60 in two series, the exterior bristle-like, the inner more robust, with 3–4 brown central spines, of which one or more are hooked. Flowers similar; berry club-shaped,

scarlet; seed globose, with a larger spongy brown appendage. — Gravelly soil in southern Utah and Arizona; rarer than the last.

M. (CORYPHANTHA) VIVIPARA, Haw., var. Simple, oval, the almost terete tubercles bearing fascicles of 5–8 reddish-brown spines surrounded by 15–20 grayish ones in a single series, all straight and very rigid, the latter 5–8 lines, the former even 10 lines long. Flowers purple, often 2 inches or more in diameter, with numerous lance-subulate petals and fringed sepals; berry oval, green; seed pitted, light brown. — Near St. George, southern Utah (J. E. Johnson). Larger than the often cespitose forms of the eastern slopes and plains. Another simple [116] form, but scarcely half as large, occurs in Colorado, and possibly in eastern Utah.

M. NUTTALLII, Engelm. Smaller, globose, simple or sometimes cespitose, with fewer (10–20), weaker, ash-colored spines. Flowers yellow, 1–2 inches broad; berries scarlet, subglobose; seeds few, black, globose, pitted. — Common on the eastern slopes of the mountains of Colorado, and perhaps to be found in eastern Utah.

ECHINOCACTUS SIMPSONI, Engelm. Simple, globose or depressed, with ovate tubercles like a *Mamillaria*, bearing about 20 outer ash-colored spines and 5–10 stouter darker inner ones, all straight and rigid. Flowers from the top of the just developing tubercles, small, 9–12 lines broad, yellowish-green to purplish; scales on the ovary very few; berry small, dry, with few black tuberculated seeds. — Butte and Kobe valleys, Utah (H. Engelmann); frequent on the eastern slopes of the Rocky Mountains, Colorado. Flowering in April and May. [Found on the Havallah, Battle, and Toyabe mountains, and above Thousand Spring Valley, Nevada, only on high rocky ridges, 7,000–8,000 feet altitude. July in flower. Heads 2–5 inches in diameter, often clustered, the fleshy interior frequently colored. S. W.] A small variety, resembling forms of *M. vivipara* in habit, but the tubercles grooveless and fruiting at top, has spines 4–6 lines long, the inner scarcely different. A larger form has much larger tubercles and spines, often 12–14 lines long, the inner ones bright reddish-brown. (433.)

E. WHIPPLEI, Engelm. & Bigelow. Middle-sized, globose or oval, with 13 interrupted ribs. Outer spines 7–11, mostly ivory-white, the owest darkish, the upper much longer, flat and often curved; central spines 4, the upper broader, longer, white, the others brown, the lowest hooked. Flowers greenish-red, with few (2–5) sepals on the ovary, 9–15 lines long, not quite so wide; seeds few, large, tuberculate. Heads 3–5 inches high; spines 3–20 lines long. — On the lower Colorado (Bigelow, Newberry); in Desert Valley, west of Sevier Lake, Utah (H. Engelmann); the latter with more radial spines, and often with more than one hooked.

E. POLYANCISTRUS, Engelm. & Bigelow. Medium-sized, oval, with 13–17 interrupted ribs. Outer [117] spines 20 or more, white, the uppermost broader and longer; central spines 5–10, upper one broadest, longest, white, curved, the others brown, terete, mostly hooked. Flowers yellow, large, 2–2½ inches long and wide, with about 8 fringed sepals on the ovary; seeds as in the last. — Headwaters of the Mohave (Bigelow) to the sage-plains of western Nevada (Gabb). The southern form 4–10 inches high, with longer spines (the longest 3–5 inches); the northern but 3–4 inches high, with spines rarely more than 2 inches, the radial ones but ¼–1 inch long.

E. PUBISPINUS, Engelm. Small (only 2 inches high), oval, with 13 compressed sinuate ribs. Outer spines 6–10, bristle-like, 1–4 lines long, the uppermost longest, often curved or hooked, with or without a stouter hooked central one, all usually densely pubescent. Flower and fruit unknown. — Found by H. Engelmann in Pleasant Valley, near Salt Lake Desert.

E. JOHNSONI, Parry MSS. Medium-sized (4–6 inches high), oval, with 17–21 low, rounded, interrupted, close-set, often oblique ribs, densely covered with stoutish reddish-gray spines; the outer 10–14, ½–1¼ inch long, the upper longest; the central 4 stouter, recurved, 1½ inch long. Flowers large, 2–2¼ inches long and wide, purple or pink, with numerous reniform sepals on the ovary and tube, and ovate obtuse petals; seeds reticulate-pitted. — Discovered about St. George, in southern Utah, by J. E. Johnson, whose zeal for the development of the natural history and resources of his region is commemorated in the name of the species.

E. POLYCEPHALUS, Engelm. & Bigelow. Usually with several heads, often over a foot high, with few very stout annulated curved spines and very early flowers, the base of which, as well as the fruit, is enveloped in dense cotton. — From the Mohave region, and may be looked for in southern Nevada.

CEREUS ENGELMANNI, Parry. Heads several, 4–12 inches high, cylindric or ovate, with 11–13 ribs, bearing bunches of about 13 pale acicular radiating spines, 3–6 lines long, and about 4 darker (yellow, brown, [118] or black), stout and angular, straight or curved central ones, 1–3 inches long. Flowers very numerous, large (2½ inches broad or more), purple, diurnal. — From Salt Lake Desert (H. Engelmann) to Silver Peak in the Sierras (Gabb), and southward to southern Utah (Johnson) and the Mohave country (Bigelow).

C. VIRIDIFLORUS, Engelm. With very short, pectinate, pale, and reddish-brown spines and small green flowers. — Common in Colorado, and may be found in Utah.

OPUNTIA (PLATOPUNTIA) BASILARIS, Engelm. & Bigelow. Low; joints 5–8 inches long, obovate or triangular, proliferous from their base, pubescent, unarmed, but beset with numerous dense fascicles of short brownish bristles, as

is also the ovary. Flowers large, 2½ inches in diameter, purple; fruit dry, with large and thick seeds. — Nevada, in the Silver Peak region south of Walker's Lake (Gabb), and southward.

O. SPHÆROCARPA, Engelm. & Bigelow, var. (?) UTAHENSIS, Engelm. Prostrate; joints small, orbicular-ovate, 2–3 inches long and nearly as wide, thick. Spines in the axils of the minute subulate leaves, few and mostly weak or solitary or none, with few and very short bristles. Flowers 3 inches in diameter, pale yellow; fruit oval, almost spineless, at last dry. — In the pass west of Steptoe Valley, Utah (H. Engelmann).

O. MISSOURIENSIS, D. C. Prostrate; joints medium-sized, obovate or almost orbicular, tuberculate; leaves minute, subulate, all bearing in their axils 5–10 radiating or deflexed spines, 1–2 inches long, often with a few erect darker ones. Flower large, 3 inches broad, yellow; ovary and dry fruit spiny. — Quite variable, especially in the stoutness and color of the spines. From the upper Missouri to the Canadian and New Mexico, and throughout the Salt Lake basin. [Found in Salt Lake Valley and the Wahsatch, 4,200–6,500 feet altitude. July in flower. Joints sometimes 6 inches long and 4 inches broad. S. W.] (434.)

O. HYSTRICINA, Engelm. & Bigelow. Very similar to the preceding, and probably only a form of it, with [119] longer and more numerous gray or reddish spines, longer yellow bristles, and usually smaller flowers. — New Mexico; between Walker and Carson rivers (H. Engelmann), and Owen's Valley (Gabb), Nevada. [Found abundantly in Monitor and Thousand Spring valleys, Nevada, 5,000–6,000 feet altitude. July in flower; September in fruit. Flowers either purple or sulphur-yellow, scarcely smaller. S. W.]. (436.)

O. RUTILA, Nutt. Similar to *O. Missouriensis;* joints often larger, 3 inches by 4 inches, covered with closely set bunches of mostly radiating and deflexed spines, the larger ones flattened and often twisted. Flowers rose-red; ovary and dry berry spiny. — From Fillmore to St. George, Utah (Dr. Palmer, J. E. Johnson). A rediscovery of Nuttall's long-lost plant, who found it near the Green River in southern Wyoming.

O. ERINACEA, Engelm. & Bigelow. Pacif. R. R. Surv., 4. 47, tab. 13. Diffuse, ascending; joints thick, ovate, 2–2½ inches long, or sometimes elongated and almost cylindric, densely covered with clusters of 3–5 radiating spines, slender, ½–1½ inch long, very rigid, reddish-gray, with 2–4 smaller ones below; berry ovate, 1¼ inch long, with crowded clusters of 12–20 mostly deflexed spines, 3–6 lines long. — Near Mohave Creek, southern California (Bigelow). [A specimen in Herb. Gray., collected by Dr. Bloomer near Virginia City, Nevada (not seen by Dr. Engelmann), may belong to this species. S. W.]

O. FRAGILIS, Nutt. Joints small, ovate, compressed or tumid or even terete, 1–1½ inch long, fragile; larger spines 4, cruciate, mostly yellowish brown, with 4–6 smaller white radiating ones below; bristles few. Flowers smaller, yellow; fruit smaller, with 20–28 clusters of bristles, only the upper ones with a few short spines; seeds few, regular. — On the upper Missouri and Yellowstone, southward probably to New Mexico. [Found at the west base of the Wahsatch, in Jordan Valley. Specimens not seen by Dr. Engelmann, but doubtless of this species. S. W.] (437.)

O. (CYLINDROPUNTIA) PULCHELLA, Engelm. Low, 3–10 inches high, spreading. Joints small, slender, 1–3 inches long, 6 lines thick, clavate, tuberculated, with bunches of straight radiating spines 6–18 lines long, from white to nearly black, one or more of the inner longer ones flattened. Flowers purple, ½ inch or less in diameter; ovary and dry berry bearing numerous flexible, not barbed bristles. — Near Walker's River, Nevada (H. Engelmann, Gabb). [Frequent in the valleys of western Nevada from the Trinity Mountains to Monitor Valley, 4,000–5,000 feet [120] altitude; May–August. A very showy species, with sometimes 50 flowers upon a single plant; main stem erect, becoming 9 lines in thickness, and occasionally showing 25 annual rings. S. W.] (438.)

O. ARBORESCENS, Engelm. 3–5 feet high or more, with horizontal branches, cylindric, strongly tuberculated joints, numerous sheathed spines, large purple flowers, and tuberculated unarmed fruit. — New Mexico and Arizona, and probably farther northward.

O. ACANTHOCARPA, Engelm. & Bigelow. Similar to the last; rather more slender, and with more erect branches, smaller copper-colored flowers, and rather even, spiny fruit. — Arizona, and probably southern Utah.

O. FRUTESCENS, Engelm. 2–4 feet high, with slender terete joints 3 lines in thickness, very small yellow flowers, and scarlet berries. — From Texas to southeastern California, and probably farther northward.[1]

[1] For the BOTANY OF CALIFORNIA, by W. H. Brewer and Sereno Watson, Dr. Engelmann contributed the article *Cactaceæ*. But as all but one of the species had already been published, only this one is here inserted. — EDITORS.

MAMILLARIA ARIZONICA, n. sp. *Coryphantha:* globose or ovate; tubercles long-cylindrical, ascending, deeply grooved, bearing numerous straight, rigid spines; the 15 to 20 exterior spines whitish, 3 to 6 interior stouter and deep brown above; flowers large, rose-colored; sepals 30 to 40, linear-subulate, fimbriate; petals 40 to 50, lance-linear, curved; stigmas 8 to 10, white; berry oval, green, with obovate, compressed, pitted, light brown seeds.

On sandy and rocky soil in northern Arizona, from the Colorado eastward (Coues, Palmer, F. Bischoff), and into southern Utah (J. E. Johnson); probably in southeastern California. Larger in all its parts than *M. phellosperma*, 3 or 4 inches thick; tubercles an inch long; spines 5 to 15 lines long; flowers 2 to 2½ inches wide, very showy. — Vol. I. p. 244.

XII. CACTACEÆ OF SIMPSON'S EXPEDITION.

From Report of Exploration across the Great Basin of the Territory of Utah for a direct Wagon-Route from Camp Floyd to Genoa, in Carson Valley, in 1859, by Captain [now Colonel] J. H. Simpson, U. S. Engineer. Washington, 1876. Engineer Department, U. S. A.

The geographical limits of the area of this curious American family have been considerably enlarged by this Expedition, proving the presence of at least seven species in the Utah Basin between the thirty-eighth and fortieth parallels, — namely, two Echinocacti, one Cereus, and four Opuntiæ. Several species known before have been found in new localities, and three new and very distinct species have been discovered, — two Echinocacti and one Opuntia. [436]

Mamillaria vivipara, Haworth, Suppl., p. 72; Torrey & Gray, Fl. N. Amer. 2, p. 554; Engelm. Synops. Cact., p. 13. *Cactus viviparus*, Nuttall, Gen. 1, p. 295. Was collected in the South Pass and on Sweetwater River. It extends from here to the mountains of Colorado and New Mexico; but its most characteristic forms are peculiar to the more elevated plains, where it assumes that cespitose, spreading appearance from which it has received its name. The mountain form usually makes larger heads, but remains single or branches out very sparingly. Its large purple flowers, with numerous lance-linear, long acuminate, bristle-pointed petals, and its leather-brown pitted seeds, readily distinguish it from allied species.

Echinocactus Simpsoni, sp. nov.:[1] simplex, subglobosus seu depressus, basi turbinatus, mamilliferus; radicibus fasciculatis; tuberculis laxis ovatis apice oblique truncatis axilla nudis, junioribus leviter compressis basi deorsum productis, vetustioribus obcompressis basi dilatatis; areolis ovatis seu ovato-lanceolatis, nascentibus albo-villosissimis mox nudatis; aculeis exterioribus sub-20 radiantibus tenuibus rigidis rectis albidis, additis supra aculeis 2–5 setaceis brevibus, interioribus 8–10 robustioribus obscuris erecto-patulis, areola florifera sub tuberculi apice areolæ aculeigeræ contigua circulari; floribus in vertice dissitis minoribus; ovario abbreviato squamis sepaloideis triangulatis paucissimis (1–3) instructo; sepalis tubi brevis late infundibuliformis orbiculatis seu ovatis obtusis membranaceo-marginatis crenulatis fimbriatis, sepalis superioribus 10–12 ovatis obtusis integriusculis, petalis 12–13 oblongis apice crenulatis cuspidatis ex virescente roseis; stigmatibus 5–7 brevibus erectis, bacca parva viridi sicca umbilico latissimo truncata squamis paucis subinde aculeiferis instructa flore marcescente demum deciduo coronata irregulariter basi seu latere dehiscente; seminibus magnis obovatis obliquis minute tuberculatis, hilo magno ovato subbasilari, embryone circa albumen parcum fere circumvoluto hamato. [437]

Var. β. minor: tota planta, tuberculis, aculeis, floribus seminibusque minoribus.

Butte Valley, in the Utah desert, and Kobe Valley, farther west. Flowers in April and May; fruit in June and July. Var. β. comes from the mountains of Colorado. — This, and the New Mexican *Echinocactus papyracanthus*,[2] the Mexican *E. horripilus*, Lem., and perhaps the South American *E. Odierii*, Lem., and *E. Cummingii*, Salm, and probably one or two others, form the small group of *Echinocacti*, with the appearance of *Mamillaria* (*Theloidei*, *tuberculis spiraliter dispositis distinctis*, Salm, Cact. Hort. Dyck, 1849, cult., p. 34). They constitute the closest and most imperceptible transition to *Mamillaria*, subgen. *Coryphantha*, Synops. Cact., p. 8, which bear the flowers in the axils of the nascent tubercles, the flower-bearing and the spine-bearing areolæ being connected by a woolly groove. In *M. macromeris*, Engelmann, they come from the middle of the tubercle (Cact. Mex. Bound., tab. 15, fig. 4), and in the *Theloidei* they advance to the top of the tubercle, close to the spines, thus assuming the position which the flowers regularly occupy in the genus *Echinocactus* (see Cact. Mex. Bound., tab. 20, fig. 2; tab. 21; tab. 25, fig. 1; tab. 27, fig. 1; tab. 28, fig. 2).[3] The ovary is also almost naked, like that of *Mamillaria* generally, or has only a few scales, like that of *M. macromeris*. On the other hand, the dry fruit, — such as is often found in *Echinocactus*, but never in *Mamillaria*, — the tuberculated black seeds, and especially the large and curved embryo, and the presence of an albumen, do not permit a separation from *Echinocactus*.

[1] An extract of this description was published in the Transactions of the St. Louis Academy of Sciences, Vol. II. p. 197 (1863).

[2] The plant I formerly described as *Mamillaria papyracantha*, Plant. Fendl., p. 49, Synops. Cact., p. 8, proves to belong to this section of *Echinocactus*. A closer examination of Mr. Fendler's original specimen shows that the floral areola joins the spiniferous one at the apex of the small nascent tubercles. Thus far Mr. Fendler's specimen, found near Santa Fé, has remained the only one ever obtained of this pretty species.

[3] *Echinocactus brevihamatus*, Engelm., forms an exception. In this species the flowers are situated exactly as in *Coryphantha*, at the base of the tubercle, and connected with the distinct spiniferous areola by a woolly groove. (See Cact. Mex. Bound., tab. 19, fig. 2 and 3.)

This species is further interesting because it again strikingly proves that the general appearance, the [438]
habitus, of a cactus plant not necessarily indicates its real affinities. Not only is it a true *Echinocactus*, notwithstanding every appearance of a *Mamillaria*, but it is moreover closely allied in all its essential characters to the very compact *E. intertextus*, Engelm., Cact. Mex. Bound., p. 27, tab. 34, in which all traces of tubercles are lost in the straight ribs. It has the same small flowers and the same small dry fruit, containing few large seeds, of similar structure, though not entirely the same arrangement of the spines.

Full-grown specimens of our plant are 3–5 inches high and 3–4 inches in diameter, of dark green color, tubercles loosely arranged in $\frac{8}{2}\frac{}{1}$ or $\frac{13}{3}\frac{}{1}$ order, 8 and 13 spirals being most prominent; they are 6–8 lines long, at base somewhat quadrangular, 6–7 lines wide in the vertical and 4–5 lines in the transverse diameter, becoming subcylindric upward; areolæ 3–4 lines long, a little more than half as wide; the fruit-bearing tubercles are rather stouter and shorter. Exterior spines 4–6 lines long, whitish; interior ones spreading, stouter, and a little longer (5–7 lines long), yellowish, and upward deep brown or black; no truly central spine. In the very young plant the spines — 18–20 in number and only 1–1½ lines in length — are all radiating, closely fitting with their compressed bulbous bases on a linear areola, resembling in shape and arrangement those of *Cereus cæspitosus*. Soon afterward the areola becomes wider, and 6 or 8 short, stout, brown interior spines make their appearance, divergent like the original ones; next the ordinary arrangement, as described above, takes place.

It seems that quite early in spring the young tubercles on the vertex of the plant begin to form, exhibiting their densely woolly tops; and soon afterward, long before any spines make their appearance, the tips of the smooth brown flower-buds come out. The flowers are 8–10 lines long and of nearly the same diameter, externally greenish-purple; petals yellowish-green or verging to pale purple. The short stamens arise from the whole surface of the tube, leaving only a very small nectariferous space in its base. The fruit is about 3 or 3½ lines long and almost as wide, borne on a very large circular areola, surrounded by a woolly margin (see tab. 2, fig. 1). It bears toward its top 1–3 scales, sometimes with 1 or 2 small spines in their axils. The fruit usually opens by an irregular lateral slit; falling off, its base remains attached to the areola, as is the case in many (or all? or only all the dry-fruited?) *Echinocacti*, thus producing a basal opening (see tab. 2, fig. 5). Seeds 1½ line long in the longest diameter, covered with minute close-set tubercles; the young seedling shows erect, pointed cotyledons, and when a few weeks old begins to develop its pubescent spines.

Var. *β*. has been received this fall from the Colorado gold region.[4] The smallest specimens were 1 inch in diameter, globose; the small tubercles in $\frac{8}{2}\frac{}{1}$ order; spines 1½–2 lines long, often curved, sometimes 1–3 darker stouter ones in the centre. The larger specimens are almost of the size of those of Utah, but often depressed at top; tubercules arranged in $\frac{13}{3}\frac{}{4}$ or even $\frac{21}{5}\frac{}{4}$ order; spines only 4–5 lines long, 20–28 external and 6 or 7 internal ones. This species has been named in honor of the gallant commander of the expedition.

E. PUBISPINUS, sp. nov.:[5] parvulus, turbinatus, costis 13 subobliquis compressis interruptis tuberculatis; [439]
areolis orbiculatis, aculeis brevibus, rectis seu sæpe curvatis albidis apice adustis velutinis demum nudatis, radialibus superioribus 1–2 robustioribus, longioribus rectis curvatis seu hamatis, ceteris 5–8 brevioribus; aculeo centrali deficiente seu singulo robustiore longiore arrecto sursum hamato; flore?; fructu?.

Pleasant Valley, near the Salt Lake Desert; found May 9 without flower or fruit. Plant 2 inches high, 1 or 1¼ in diameter; compressed tubercles 4–6 lines distant from one another, confluent in 13 ribs. Radial spines 1–4 lines long, white pubescent or almost tomentose, more so than I have observed in any other cactus. On the lower areolæ I find only 5–6 spines, the upper ones a little longer and stouter than the balance; farther upward the number increases to 10, one or more of the upper ones becoming still stouter and often hooked; at last here and there a single central spine makes its appearance, 5–6 lines long, the strong hook always turned inward or upward. At first only the dusky point of the spine is naked; with age the whole coating seems to wear off. In another specimen I find the spines 8–12 in number, a little longer, more slender, all radiating. The small supraspinal areola proves this plant to be an *Echinocactus;* it probably belongs, together with the next, to the section *Hamati*, Synops. Cact., p. 15.

E. WHIPPLEI, Engelm. & Bigelow, Pacif. Rail. Rep. IV. Cact., p. 28, tab. 1; Synops. Cact., p. 15. Var. SPINOSIOR: globosus; costis 13 compressis interruptis, aculeis radialibus 9–11, inferioribus sæpe obscurioribus, reliquis longioribus niveis, 2 superioribus sæpe elongatis complanatis curvatis; centralibus 4, summo elongato [440]
complanato pergamentaceo flexuoso albo, 3 reliquis paulo brevioribus obscuris omnibus seu solum infimo hamatis; floribus minoribus; ovario squamis sepaloideis 5 oblongis munito; sepalis tubi linearibus margine membranaceis integris mucronulatis, petalis angustis oblongis; stigmatibus 6–7 brevibus in capitulum globosum congestis; bacca ovata parce squamata floris rudimentis persistentibus coronata.

[4] It here grows and thrives, probably at a higher elevation than any other northern Cactus, occupying, *e. g.*, the gravelly moraines of the glacial period of Clear Creek Valley, between 8,000 and 9,000 feet altitude, and, in the southern part of the Territory, the Sangre de Cristo Pass, 10,000 feet high.

[5] This description has been published in Trans. St. Louis Acad., Vol. II. p. 199 (1863). It is rather strange that neither this nor the above-mentioned *E. papyracanthus* has ever been found again (January, 1876).

The species was originally discovered on the Little Colorado by Dr. Bigelow, and was found afterward on the same stream by Dr. Newberry. The variety here described was met with more than five degrees farther north, in Desert Valley, west of Camp Floyd ; remains of fruit, with the withered flowers attached, and some seeds, were found concealed between the spines, from which the description has been drawn.[6] Globose heads 3 inches in diameter; radial spines ½–1½ inch long, central ones 1½–2 inches in length. Flowers, if I may judge from the withered remains, about 1 inch long ; ovary small, bearing about 5 membranaceous scales, the lower triangular, the upper oblong-linear, almost entire, and never cordate or auriculate at base, as they appear in most of the allied species ; sepals of tube also narrow, linear, or oblong-linear, 2–5 or 6 lines long, ½–1 line wide ; stigmas about ½ line long. Fruit apparently an oval berry, ½ inch long. Seed just as it is described and figured in Whipple's Cactaceæ ; the tubercles on the seed-coat are extremely minute and distant from one another, each forming a central protuberance on the otherwise flat surface of an angular cell of two or three times the diameter of the tubercle itself; embryo curved about ¾ around a rather copious albumen.

CEREUS VIRIDIFLORUS, Engelm. in Wisliz. Mem., note 8, sub Echinocereo ; Cact. Mex. Bound., tab. 36 ; Synops. Cact., p. 22. This is evidently the northernmost *Cereus*, extending to the upper Platte ; it is abundant in Colorado. These northern specimens are 1–3 inches high, 13-ribbed, and show the greatest variability in the color of the radial spines ; in some bunches they are all red, in others white. In others again the colors are distributed without much regularity ; sometimes the upper and lower spines are white and the lateral ones red, or a few or even a single one above and below are red and all the rest white, or the lower ones are red and the upper ones white, and all these variations sometimes occur on the same specimen. I mention this to show how little reliance can be placed on the colors or the distribution of the colors of the spines. Central spines wanting, or one or two projecting horizontally, straight or curved upward, white or tipped with purple or all purple, 6–9 lines in length.

C. ENGELMANNI, Parry in Sillim. Journ., n. ser. 14, p. 338 ; Engelm. Cact. Bound., p. 36, tab. 57 ; Synops. Cact., p. 27. Deserts west of the Salt Lake, without flower or fruit. Specimen entirely similar to the one figured in the Cactaceæ of the Boundary. The species seems to extend from the Salt Lake region southwestwardly to Arizona and the Mohave country.

OPUNTIA SPHÆROCARPA, Engelm. & Bigelow, Pacif. Rail. Rep. IV. Cact., p. 47, tab. 13, fig. 6–7 ; [441] Synops. Cact., p. 44. Var. ? UTAHENSIS : diffusa, læte-virens, articulis orbiculato-obovatis, crassis, junioribus sæpe globoso-obovatis ; areolis subapproximatis ; foliis minutis subulatis divaricatis ; setis brevissimis paucis stramineis ; aculeis nullis seu parvulis nunc singulo longiore recto robusto albido ; floribus sulphureis, ovario obovato areolis fusco-tomentosis sub-25 instructo, sepalis exterioribus transversis obcordatis cuspidatis ; petalis 8 late-obovatis emarginatis ; stylo vix supra stamina exserto ; stigmatibus 8 brevibus erectis ; bacca obovata areolis plurimis tomentosis stipata ; seminibus numerosis irregulariter compressis anguste marginatis.

Pass west of Steptoe Valley, in the western mountains of the Basin ; found July 19 in flower and fruit. Joints 2–3 inches long and of almost the same diameter, often over ½ inch in thickness, sometimes almost terete, or rather egg-shaped ; areolæ 6 or 8 lines apart ; leaves very slender and acute, scarcely 1 line long, smaller than in any other of our species except *O. basilaris*, also a western form from the lower Colorado ; bristles few, and even in old joints scarcely more than ½ line long ; spines none, or on the upper areolæ a few short ones, with here and there a stouter one ¾–1 inch in length. Flowers nearly 3 inches in diameter, pale or sulphur-yellow ; when fading, reddish. Fruit about 1 inch long and half as wide, with a deep umbilicus, and with 20–25 areolæ, which sometimes show a few bristles or a minute spine. Seeds very irregular, 2, or, in the largest diameter, sometimes 2½ lines wide.

Unwilling to increase the number of ill-defined species in this most difficult genus, I attach this plant to the only species known to me to which it possibly can be compared, — *O. sphærocarpa*, from New Mexico, — though its fruit is not spherical, has not a shallow umbilicus, and is, at least in the specimen before me, not dry. The latter would be an insuperable distinction, if we might not suspect, what in fact is often the case, that the fruit later in the season would become dry and brittle. The leaves — which heretofore have been entirely too much neglected as a diagnostic character in this genus — and the flowers of the original *O. sphærocarpa* are unknown thus far.

O. TORTISPINA, Engelm. & Bigelow, l. c., p. 41, tab. 8, fig. 2–3 ; Synops. Cact., p. 37. Forks of the Platte ; in flower in July. The specimens being very incomplete, I am not quite sure that this is the same species as that of Captain Whipple's Expedition ; the joints appear to be somewhat smaller, the areolæ closer together, and the spines shorter (1–1½ inch) and rather weaker. It may possibly prove to be an extreme form of *O. Rafinesquii*, the area of which extends to the Rocky Mountains. Leaves subulate, 2 lines long ; flowers 2⅓–3 inches in diameter, sulphur-yellow ; ovary long (1–1½ inch), with 20–30 areolæ, with light brown wool and short bright brown bristles ; exterior sepals obovate, lance-cuspidate ; petals 6–8, broadly obovate, obtuse, crenulate ; stigmas 6–8, short, erect, as long as the stamens.

[6] The botanist of Dr. Hayden's Expedition of 1875, Mr. Brandegee, found it abundantly in southwestern Colorado.

O. HYSTRICINA, Engelm. & Bigelow, l. c., p. 44, tab. 15, fig. 5–7; Synops. Cact., p. 43. A flowering specimen, collected in June between Walker and Carson rivers, is exactly like one found by Dr. Bigelow on the Colorado Chiquito. It has slenderer and straighter spines than the one figured in Whipple's Report, and approaches somewhat to *O. erinacea*, Engelm. & Bigelow, of the Mohave region, in which I now recognize the long-lost *O. rutila*, [442] Nutt. in Torr. & Gray, Flor. 1, p. 555. Joints 5 inches long, half as wide, obovate; leaves 1½ lines long; areolæ closely set with long straw-colored bristles; lower ones with few and short white spines, upper ones with numerous grayish-red spines 1½–2 inches in length. Flowers pale straw-colored, 2½–3 inches in diameter; ovary 1 inch long, with 20–30 white woolly aculeolate areolæ; exterior sepals oblanceolate, squarrose, or recurved at the elongated tip; petals obovate, obtuse, crenulate; style with 8 or 10 short erect stigmas, longer than the stamens. The squarrose tips of the sepals are particularly conspicuous on the bud.

O. MISSOURIENSIS, De Cand. Prod. 3, p. 472; Torr. & Gray, Flor. 1, p. 555 (in part). *Cactus ferox*, Nutt. Gen. 1, p. 296. From the deserts of Salt Lake Valley to Rush Valley; specimens without flower or fruit. Joints small (2–3 inches long), broadly obovate or circular; areolæ closely set; spines numerous, stiff, stout, angular, white, mostly deflexed.

O. MISSOURIENSIS, var. ALBISPINA, Engelm. & Bigelow, l. c., p. 46, tab. 14, fig. 8–10; Synops. Cact., p. 44. Smith Creek, Lookout Mountains, in western Utah; flowering in July. By their slender flexuous spines the specimens approach to var. *trichophora*. Flowers 3–3½ inches in diameter, bright golden-yellow; ovary 1 inch long, with 20 or 25 areolæ, scarcely spiny; exterior sepals obovate, cuspidate; petals about 8, obtuse, crenulate; style shorter than the stamens; stigmas about 5, very short, erect. Some flowers have elongated and very spiny ovaries, evidently abortive.

O. FRAGILIS, Haworth, Suppl., p. 82; Torr. & Gray, Flor. 1, p. 555; Synops. Cact., p. 45. *Cactus fragilis*, Nutt. Gen. 1, p. 296. Fort Kearny to the North Platte country; in flower in June and July. This is, I believe, the first time that the flowers of this species were collected since Nuttall's discovery of it in 1813. Travellers report that the plant is very frequently seen in the sterile prairies east of the Rocky mountains, but that it is rare to find them in flower, and rarer still in fruit. Since many years I have the plant in cultivation from specimens brought down by Dr. Hayden, but have not been able to get it to flower. Nuttall only informs us that the flowers are solitary and small. In the specimen before me they are yellow, scarcely 2 inches in diameter; ovary 8–9 lines long; the 13–15 areolæ are densely covered with thick white wool, the upper ones bear a few white spines; lower sepals broadly oval, with a short cusp; petals 5, obovate, rounded, crenulate; style longer than the stamens; stigmas 5, short, erect, cuspidate.*

O. PULCHELLA, sp. nov.:[7] parvula cæspitosa diffusa; articulis parvis obovato-clavatis; foliis minutis [443] e basi ovata subulatis; areolis confertis, superioribus aculeos albidos rectos, singulum longiorem complanatum porrectum seu deflexum alios brevissimos radiantes gerentibus; floris purpurei ovario areolis 13–15 convexis albo villosissimis et longe setosis dense stipato; sepalis inferioribus lineari-oblongis breviter cuspidatis, superioribus spatulatis; petalis sub-8 obovatis obtusis, stylo cylindrico exserto, stigmatibus 5 linearibus suberectis; bacca sicca setosissima, seminibus crassis rhaphe lata plana notatis.

Sandy deserts on Walker River;[8] flowers in June. — This is one of the smallest, as it is one of the prettiest, species of this genus. It belongs to the small section of *Clavatæ* (Synops. Cact., p. 46) of the cylindric *Opuntiæ*, but is distinct from all those known to me by its small joints and purple flowers; all the others have, so far as I know, yellow flowers. Joints 1-1¼ inch long, 4–6 lines thick, very slightly tuberculated; leaves scarcely 1 line long; areolæ crowded, white woolly. Larger central spine on the upper areolæ 4–6 lines long, flat, and somewhat rough above, convex below; smaller ones 4–6 or 10, radiating, ½–1½ line long. Flowers crowded, of a beautiful bright purplish-red or deep rose-red color, 1¼–1½ inch in diameter; ovary 4–5 lines long, beset with white capillary spines, 3–5 lines long, 15–20 on each areola; style not ventricose, as is usual in the genus, but cylindric; stigmas slender, pale yellow; berry clavate, at last dry, about 1 inch long, well marked by the conspicuous white-woolly areolæ and their numerous purplish-brown, flexible, hair-like bristles, 4–6 or 7 lines long. These bristles are entirely destitute of the minute barbs which otherwise invariably characterize spines and bristles of *Opuntiæ*. The thick round seeds, 2 lines in diameter, are well distinguished by a broad rhaphe, much wider than I have seen it in any other clavate *Opuntia*.

* This note, containing the character and description of *Opuntia Pes Corvi*, having been printed in the preceding article (p. 226), is here omitted. — EDITORS.

[7] An account of this species was given in the Transactions of the St. Louis Academy, II. p. 201 (1863).

[8] This pretty species was afterward (1867) collected "among the sage brushes" of Nevada, by Mr. William Gabb; and in the following year by Mr. S. Watson, "frequent in the valleys of western Nevada, from the Trinity Mountains to Monitor Valley, 4,000–5,000 feet alt."

EXPLANATION OF PLATES.

Plate I. *Echinocactus Simpsoni* as it appears in early spring. On the vertex a young growth of tubercles is visible, their tops covered with wool.

Plate II. Details of the same.

Fig. 1. Four tubercles from near the vertex: one shows the broad scar where the fruit has fallen off; another one is just developing its spines, exhibiting their points above the thick wool.

Fig. 2. A detached tubercle bearing a ripe fruit.

Fig. 3 and 4. Flowers with the upper part of the tubercle and its young spines.

Fig. 5 and 6. The fruit magnified three times; fig. 5 showing the basal opening, fig. 6 the broad umbilicus.

Fig. 7. A scale of this fruit more magnified, with two axillary spines.

Fig. 8–12. Seed: fig. 8 natural size, the others eight times magnified; fig. 9 lateral, fig. 10 dorsal, fig. 11 basal view; fig. 12 part of the surface, highly magnified.

Fig. 13. Embryo, enveloped in the inner seed-coat, including also the albumen, magnified.

Fig. 14. Lateral, fig. 15 frontal view of the embryo, magnified.

Fig. 16. Seedling, a few weeks old, magnified.

Fig. 17. Tubercles of the smaller variety, from Colorado, in every state of development.

Plate III. Fig. 1. Part of a plant of *Opuntia pulchella*, showing a flower-bud and two flowers, natural size.

Fig. 2–4. Bunches of spines, four times the natural size.

Fig. 5. Section of a larger spine, more magnified.

Fig. 6. A leaf from an ovary, with the axillary woolly and bristly areola, four times natural size.

Fig. 7. A fruit.

Fig. 8–9. Seed, four times magnified; fig. 9 showing the broad rhaphe.

XIII. CACTACEÆ OF WHEELER'S EXPLORATION.

FROM REPORT UPON UNITED STATES GEOGRAPHICAL SURVEYS WEST OF THE ONE HUNDREDTH MERIDIAN, IN CHARGE OF FIRST LIEUTENANT GEORGE M. WHEELER, U. S. ENGINEERS. Published by ENGINEER DEPARTMENT. Vol. VI., BOTANY, by J. T. ROTHROCK. 1878.

MAMILLARIA (CORYPHANTHA) VIVIPARA, Haw., Engelm. in Watson's Bot. King's Expl. 117. A common [127] plant on the western plains from the Missouri to Texas, extending in the mountain regions as far west as Arizona and South Utah. The large, deep rose-colored or purple flowers, with fringed sepals and lance-linear, acuminate petals, green oval berries, with light brown pitted seeds, readily distinguish the species. The form of the plains is lower and often densely cespitose-spreading; the mountain plant is often simple and larger. The largest form, which comes from Arizona, I had at one time distinguished as *M. Arizonica*, but must now consider it as only a gigantic *Vivipara*, 3–5 inches high, 4 inches in diameter, with spines often over 1 inch long on rather broad and spreading tubercles. Rothrock, 1874 (203), is a smaller form, from Camp Apache, Ariz.

M. (CORYPHANTHA) CHLORANTHA, sp. nov. Similar to the last, but with broader yellow petals; stems oval to cylindrical, 3 inches wide, sometimes 8–9 inches high; tubercles compressed from above; 20–25 outer spines gray, almost in 2 series; 6–8 or 9 inner ones stouter, ½–1 inch long, reddish or brownish only at the tip. Flowers yellowish or greenish-yellow, crowded on the top of the plant, 1½ inch long and wide, often 1–2 small fringed sepals on the ovary (which also occasionally is seen in *Vivipara*); sepals lanceolate, fringed; petals lanceolate or linear-lanceolate, acute, denticulate; 7–9 whitish stigmas, erect-spreading. — Southern Utah, east of Saint George (Dr. Parry, I. E. Johnson).

ECHINOCACTUS WISLIZENI, Engelm. Very large, often over 3 feet high and half as much in diameter; at first globose, then ovate to cylindrical, with 21–25 rather sharp ribs. The large linear-oblong areolæ (very [128] woolly when young) bear three kinds of spines: first, 4 very stout, annulated, reddish ones, 1½–2½ inches long, the 3 upper ones straight, the lower one hooked; second, 3–5 lower and usually 3 uppermost spines, slender, but straight, stiff, and annulated, of reddish color; third, 12–20 whitish, bristle-like, flexuous, lateral spines. Flowers 2–2½ inches long, 1½ wide, yellow, outside greenish with purple-brown; ovary and fruit imbricately covered with numerous (50–60) cordate or reniform crenulate sepals; sepals of tube oblong, ciliate; petals broadly linear, crenate, bristle-pointed; style deeply divided into 12–18 linear stigmas; seeds 1 line long or over, reticulate or shallow-pitted. — Southern New Mexico.

Var. LE CONTEI (*E. Le Contei*, Engelm.). At last clavate from a slender base; lower central spine more flattened, curved or twisted, but not hooked; flower rather smaller and with fewer parts. — This is the western form, from South Utah and Arizona to and beyond the Colorado River. Dr. Rothrock collected, at Camp Bowie, Arizona, a peculiar form (492), which may represent another variety, *decipiens:* globose, 1 foot in diameter; spines shorter and fewer, no straight spines above the 4 central ones, none longer than 1–1½ inches, 10–15 thin flexuous spines on side and upper end of areolæ; only 20–25 sepals on ovary.

E. POLYCEPHALUS, Engelm. & Bigelow (see Watson in Bot. King's Expl. 117). From the Mojave region to southwestern Utah. The numerous spiny-bristly sepals, and the linear, acute, yellow petals, almost hidden in a dense cottony wool.

E. WHIPPLEI, Engelm. & Bigelow; Watson, l. c. 116. On the Lower Colorado River, and northward into Utah.

CEREUS (ECHINOCEREUS) ENGELMANNI, Parry; Watson, l. c. 117. Throughout Arizona and into Utah and southern California. Flower purple, open only in mid-day sunshine. — Camp Bowie (1002); Mrs. Major Sumner. Flower only. May be this or an allied species.

C. (ECHINOCEREUS) PHŒNICEUS, Engelm. Globose or oval heads, 2–3 inches high, about 2 inches in diameter, several to a great many (sometimes over 100) from one base, 8–11-ribbed; 8–15 slender but straight, stiff, and very brittle spines in each bunch, ½–1½ inch long, 1–3 of them more central and a little stouter. Deep red [129] flowers, 1½–2½ inches long, half as wide, open equally day and night; spatulate, rather stiff petals, rounded at tip. — From West Texas to southern Colorado and Arizona, as far west as the San Francisco mountains (Bigelow), and from Fort Whipple (Palmer).

C. (ECHINOCEREUS) TRIGLOCHIDIATUS, Engelm. Few (2–5) globose or oval heads, 2–4 inches high, 2–2½ thick, 6–7-ribbed; areolæ more distant than in the last; spines fewer, only 3–6, flattened or angular, usually curved, about 1 inch long; flowers same as in last. — New Mexico, Santa Fé, 1874; Rothrock (39).

C. gonacanthus, Engelm. & Bigelow, — which extends from New Mexico to the Arkansas River and westward to Zuñi, and is characterized by its stouter, longer, and more numerous spines, — may belong to this species; and perhaps both, with numerous other so-called species, which vary only in the number of the ribs, the number or form of the spines, and the closeness of the spine bunches, but have all similar flowers, may have to be considered as forms of one polymorphous type (*C. phœniceus*).

OPUNTIA (PLATOPUNTIA) BASILARIS, Engelm. & Bigelow. A low plant, with broadly obovate, often retuse or fan-shaped joints, branching mostly from the base, pubescent, as well as the fruit; areolæ very close, without spines, but densely covered with short yellowish-brown bristles; flowers large, rose-purple; fruit dry, subglobose, with rather few large and thick seeds. — Southeastern California to Arizona. Distinct from all other species of this region by its mode of growth, its pubescence, the absence of spines proper, and the very large (3½–5 lines wide) seeds. The large purple flowers, which in the season completely cover the plant, make a beautiful show.

O. (PLATOPUNTIA) MISSOURIENSIS, D.C. Santa Fé, New Mexico, 1874; Rothrock (6). Common from the plains of the Missouri into the mountains. A low, very spiny (whence Nuttall's name, *O. ferox*) species, with yellow, or sometimes (on the upper Arkansas plains) purple flowers, and dry spiny pods, which contain large, much compressed, and broadly margined seeds.

Several more — probably half a dozen — flat-jointed *Opuntiæ* have been noticed in Arizona; some prostrate and with smaller joints, others tall, erect, with large joints (to a foot or more in length), many of them very spiny. Of them not much is known, as the plants are difficult to preserve, and flowers and fruit have not often been [130] found or collected. Full notes, living joints, good fruit and seed, and pressed flowers are desirable to make us sufficiently acquainted with these plants. The best method of preserving the flowers is to split them open before attempting to dry them. Living plants or joints are very valuable, but alone are not sufficient, because in cultivation they very rarely flower and scarcely ever bear fruit.

O. (CYLINDROPUNTIA) CLAVATA, Engelm. A low, cespitose plant, with short (1–3 inches high, 1 inch thick), clavate, ascending, strongly tuberculate joints, the upper areolæ bearing 4–7 ebony-white, flattened, striate spines, surrounded by a number of smaller bristly ones; yellow flowers, 2 inches wide; dry, yellow, oval pod, covered with numerous large, woolly, and long-bristled areolæ. — El Rito, New Mexico (Rothrock), in 1874 (92); also about Santa Fé, etc.

O. (CYLINDROPUNTIA) PULCHELLA, Engelm. (see Watson's Bot. King's Expl. 119; Simpson's Rep. Bot., tab. 3) A very small, purple-flowered species of Nevada. A flower brought home by Mr. Bischoff was by a singular error enumerated in the Catalogue of 1874 as *Cereus viridiflorus*.

O. (CYLINDROPUNTIA) ARBORESCENS, Engelm. (see Watson, l. c. 120). Cuero, New Mexico (101), Rothrock in 1874; Cienega, South Arizona (near Tucson), the same (584); and from Camp Bowie, Arizona (1002), by

Mrs. Major Sumner. This handsome species extends northward to the plains of Colorado and Pike's Peak, covering extensive tracts. Remarkable for its horizontal, often whorled branches; purple flowers, 2–2½ inches in diameter; ovary often with some spiny bristles, which at maturity disappear. The skeleton — as the cactus wood is rather fancifully called after the soft tissues have rotted away — forms a heavy, hollow cylinder, with regular rhombic holes or meshes corresponding to the tubercles and spine-bunches of the plant, and makes excellent canes.

This species is closely allied to the Mexican *O. imbricata* and *O. decipiens*, — *arborescens* being the northern, larger-flowered form, — but the seeds are different.

O. (Cylindropuntia) Bigelovii, Engelm. (Pacif. Rail. Rep. 4, Bot. 50, tab. 19). An erect, bushy [131] plant, 10–12 feet high, with oval or subcylindric joints, bearing on short oval tubercles 3–5 large (1 inch long) and many smaller spines, the larger ones loosely covered by glistening whitish sheaths; purple flowers, small, 1 inch wide; fleshy greenish berry; numerous small and very irregular seeds, or often abortive; wood a wide fragile tube, with short meshes.

O. (Cylindropuntia) tessellata, Engelm. Very bushy, from a stout trunk, with solid wood, sometimes several inches thick; ultimate branches as thick as a swan's quill, covered with angular, flattened, ashy-gray tubercles, the uppermost bearing at their upper end single, long, loosely yellow-sheathed spines; flowers small (about ¾ of an inch wide), yellow; small fruit, oval, covered with long, soft, brown bristles. Pacif. Rail. Rep. l. c. tab. 21. — On both sides of the Lower Colorado River, 6–7 feet high. The yellow shining spines, crowded on the upper end of each year's growth, together with the scale-like tubercles, give the plant a singular and striking appearance.

There are several other cylindric *Opuntiæ* in Arizona not collected in these Expeditions, and for the most part only imperfectly known. It is desired to direct attention to this interesting group, which, on account of the bulky forms and forbidding armament, are too much shunned by travellers. — *O. echinocarpa*, Engelm. & Bigelow, is a low and very spiny bush, with yellowish flowers and dry spiny fruit. — *O. acanthocarpa*, Engelm. & Bigelow, is taller, with elongated tubercles, or rather ridges, copper-colored flowers, and dry fruit bearing few but stouter spines. — *O. mamillata*, Schott, and *O. fulgida*, Engelm. & Bigelow, are allied to *O. Bigelovii*, with thick tubercles or prominent crests, the former with small, the other with numerous long and shining sheathed spines; fruit often abortive. Good specimens, with flower, fruit, and good seed of the same plant (so that mixing species and forms may be avoided), are very desirable, as we know scarcely anything more about them than what the botanists of the Mexican Boundary Commission (often at the most unfavorable season) could find out twenty-five years ago. — *O. leptocaulis*, D. C. (*O. frutescens*, Engelm.), the most slender *Opuntia* known, bushy, with branches like pipe-stems, small yellow flowers, and red, somewhat fleshy berries, is common from North Mexico, through Texas, to Arizona. It has been said that [132] its flowers, contrary to the habit of the genus (which has diurnal flowers, *i. e.* open in sunlight), are nocturnal, which, however, is now positively denied.

XIV. THE PULP OF CACTUS FRUIT.

From Transactions of the St. Louis Academy of Science, Vol. II., October, 1861.

Zuccarini, than whom none better understood the morphology, as well as the systematic [166] characters of the Cactaceæ, had already in the year 1845 (Plant. nov., fasc. 5, pag. 34) expressed the opinion that in Cactaceæ, as well as in Cucurbitaceæ, the *funiculi* assisted in forming the pulp of the fruit. Schleiden (Grundzüge, ed. 3, p. 408) ascribes the pulp of Mamillaria to an *arillus*, dissolving into single juicy cells. Gasparrini, in his extended but rather odd description of the Opuntiæ fruit (Osservazioni, 1853, p. 20), also considers the pulp as a peculiar sort of an arillus. I had long since come to the conclusion, especially after examining the somewhat dry fruits of *Cereus cæspitosus* and *Echinocactus setispinus*, that the funiculi alone constitute the pulp, and in Cact. Mex. Bound. tab. 20, fig. 12, I had figured the enlarged funiculi of the latter plant.

The Cactus fruit is usually succulent; only some Echinocacti and some Opuntiæ are known to bear dry fruits. The succulent fruit consists of the fleshy walls of the fruit itself, originating from the carpel and the adhering calyx (or part of the stem, as Zuccarini will have it), coalescing and forming a homogeneous mass, and of the juicy pulp, in which latter the seeds are imbedded. In

some species the parenchyma of the walls, in others the mass of the pulp, prevails. *The pulp is always the product of the funiculus or its appendages.* The funiculus, even at the flowering period, bears on its inner side a beard of transparent fibres, 0.01–0.10 line in length; the fruit maturing, these fibres are enlarged, and the whole cellular tissue of the funiculus becomes, as it were, hypertrophic, every cell swelling up, filling with a sweetish, mostly red-colored juice; at last the cells in most species separate from one another, and leave the seeds floating in the pulp attached only to the slender spiral vessels. The mass of the funiculi and their proportion to the mass of the seed is very different in different species; in *Lepismium Myosurus* it constitutes only $\frac{1}{6}$ or $\frac{1}{8}$ of the seed; in *Mamillaria Nuttallii* it bears, perhaps, a still smaller proportion; while in other Mamillariæ, e. g. *M. polythele* and *M. pusilla*, it is 2–4 times as large as the seed. In the large edible [167] fruits of *Cerei*, such as *C. triangularis, C. grandiflorus, C. giganteus*, etc., it constitutes by far the largest part of the fruit. The cells are globular, oval, or variously compressed; in some species extremely small, 0.01–0.03 line long, while in others they are 0.1–0.2 and even 0.3 line long.

The genus *Opuntia* apparently differs in having the whole seed covered with juicy cells, which, in size and quantity, vastly predominate over the cells of the rather insignificant funiculus proper. But the whole bony coating of the seed being but an arillary enlargement of the funiculus (Cact. Mex. Bound., p. 76), this peculiar case entirely falls into the analogy of the other *Cactaceæ*. The real difference is caused by the nature of the arillus, which, getting extremely hard, leaves the cells of the epidermis only to grow out, and finally to form the pulp of the fruit. Soon after fecundation these cells gradually become elongated, cylindrical, and disconnected among one another, rising perpendicularly from the surface of the seed; they are shorter, of nearly equal length, and perfectly straight, on the faces of the young seed, and longer, hair-like, and twisting in different directions on and near the rim. In *O. glaucophylla*, which I take to be a mere variety of *O. Ficus Indica*, I find them at their first appearance on a seed of less than one line in diameter only about 0.004 line long and wide; on the rim they soon grow to twice the diameter and ten times the length, till at maturity the larger ones are 0.3–0.5 line long. These cells, at first simple and cylindrical, become at last jointed and clavate, the terminal cells being many times larger than the basal ones, thus properly filling the interstices between the seeds. During winter, the fruit and seeds having reached their full growth, these cells contain a colorless, viscous, insipid fluid; in the following spring, when the fruit has assumed a deep purple color, and attained full maturity, they contain a sweetish, purple liquid, and soon separate, forming what is properly called the pulp. The single cells are mostly oval or oblong, 0.02–0.20 line in length. I find the same structure in *O. Engelmanni*, which, however, ripens its fruit, with us, in autumn, and it undoubtedly obtains in all Opuntiæ with large and juicy fruit. In *O. Rafinesquii*, and probably in all species with less juicy fruit, the cells on the face of the seed are not developed, those on the rim producing the pulp, which in this species as well as in *O. vulgaris* and *O. Pes Corvi*, remains, even at full maturity, insipid, viscous, and of pale red color. In this condition the fruit adheres to the plant, unchanged, until it falls off in the following spring.

In *O. Brasiliensis* and *O. monacantha* these epidermis-cells are greatly elongated, forming, in fact, a matted tough beard, 2–3 lines long, analogous to that of the unripe cotton-seed; each hair consists of several slender joints, 0.01–0.02 line in diameter, the terminal one often thickly clavate or otherwise variously inflated. I have found them thus in the unripe fruit late in autumn; how they may change at maturity I have been unable to ascertain.

No such development of the epidermis-cells seems to take place in the Opuntiæ with dry fruit, such as *O. Missouriensis, O. clavata*, etc.; the seed, consequently, has a whiter, polished, ivory-like surface, while that of the juicy Opuntiæ fruits is dull and almost rough, and not so white.

The cells of the parenchyma of the fruit, as well as those of the bony seed-coat, are full of aggregations of crystals; those of the funiculus proper contain fewer and smaller clusters; but in the pulp itself I have never seen them; neither could I discover any in the parenchyma, or in the pulp of the fruits of Mamillariæ.

V.

PAPERS ON JUNCUS.

I. A REVISION OF THE NORTH AMERICAN SPECIES OF THE GENUS JUNCUS, WITH A DESCRIPTION OF NEW OR IMPERFECTLY KNOWN SPECIES.

From the Transactions of the St. Louis Academy of Science, Vol. II., p. 424–498. [Issued down to p. 458, May, 1866.] 1866–1868.

The difficulty I found in arranging the species of *Juncus* of my own herbarium, the [424] doubts in which the authors left me by incomplete and unsatisfactory descriptions, and by confusion in the names and synonyms, the want of confidence which all my correspondents, even such as had paid a good deal of close attention to it, seemed to place in themselves and their own judgment when this genus was under discussion, — all this induced me to enter upon a critical study of our *Junci*. I was greatly aided by the most liberal contribution of specimens and of observations from all sides; among those to whom I am thus indebted I mention Professor Asa Gray, of Cambridge, and Messrs. E. Durand, C. E. Smith, and Professor Leidy, of Philadelphia, who sent me their own and the herbaria of the institutions under their care; Dr. J. W. Robbins, of Massachusetts; Rev. O. Brunet, of Quebec; Dr. H. P. Sartwell, of New York; Professor T. C. Porter, of Pennsylvania; Mr. M. S. Bebb, of Washington; Rev. M. A. Curtis, of North Carolina; Mr. W. H. Ravenel, of South Carolina; Dr. A. W. Chapman, of Florida; Mr. E. Hall, of Illinois; and last, but not least, Professor W. H. Brewer, of the California State Survey, and my indefatigable and ever obliging friend, Mr. H. N. Bolander, of San Francisco. In Europe I was greatly assisted by Professor Caspary, of Kœnigsberg, who compared E. Meyer's herbarium, and by Professor A. Braun and Dr. Garcke, of Berlin, who examined Willdenow's and Kunth's herbaria for me. My very particular thanks are due to all of them. Michaux's and Lamarck's plants have, thus far, been inaccessible to me, and thus some questions of synonymy must remain unsettled for the present.

A very conscientious examination of over a thousand specimens from all parts of the country, with careful dissections of their flowers and fruits, and drawing of these details, has enabled me, I believe, to place the proper value on the characters derived from the different organs of these plants, and to arrive at definite conclusions in regard to their species and varieties and their affinities among themselves.

These investigations, to be sure, were all made "in the closet" since the end of last summer, but I trust that they are not the less reliable, and that those who have the opportunity will follow them up in the field, and will enable me not only to improve upon this paper, but also to publish, with their aid (which some have already promised me) an *Herbarium Juncorum Boreali-Americanorum normale*, which will stand in place of expensive plates, and will, it is believed, be [425] far preferable to them.

Arrangement. — The numerous species of the genus *Juncus* have been divided into sections

according to characters taken from their organs of vegetation, their stems and leaves, and also their inflorescence, more than from the differences found in their flowers or fruits.[1] In these most essential parts all the species show a remarkable uniformity, which will only permit us to make use of them to characterize minor divisions, and for specific diagnosis. Desvaux (Journ. Bot., Vol. I., Paris, 1808) had already separated our *Juncus repens*, on account of a peculiarity in the dehiscence of the capsule, and some alpine species, because of their long-tailed seeds, as two distinct genera, *Cephaloxys* and *Marsippospermum*. But we know now that other species of far different alliance form a transition from the ordinary loculicidal to the septifragal dehiscence, that species of all forms and sections, and otherwise very dissimilar, have tailed seeds, and that others exhibit all the transitions from the tailed and loosely tunicated to the merely pointed and closely coated seed. From the following it will appear that these genera cannot stand even as sections.

Vegetative Organs. — The different forms of the root-stocks, and of the stems and leaves of these plants, are so well known that I need not here dwell upon them; by their differences the principal types of *Junci* are best characterized, i. e. those that produce no leaves or leaves equal to the stem itself, those that have channelled or flattened leaves, and those that bear knotted leaves. But I must say that we have forms that seem to bridge over these apparently well-marked distinctions, and which again prove that Nature knows nothing of our systematic subtleties, and that our systems are only an imperfect aid for our limited comprehension. To give an example — no section of *Juncus* seemed to be better characterized and more natural than that of the true *Junci* with naked stems and so-called lateral inflorescence. To this section we are bound to refer *J. Drummondi* and *J. Hallii*, while *J. biglumis*, which can scarcely be separated from them, is, in all our systematic works, far removed from them. Again, *J. Vaseyi* comes so close to *J. Hallii* that we should hesitate whether to class it with this or with the flat-leaved *J. tenuis*, if *J. Greenii* did not unite it more directly with the latter. The form of leaves is not quite constant. While those of the articulate *Junci* are usually described as terete or compressed-terete, the observations of our southern botanists prove that in some species, at least, soil and moisture have a most important influence on [426] them, as they also have on the development of the inflorescence; the overgrown forms of *J. scirpoides*, as I understand that species, have large, laterally compressed, gladiate leaves, while in the forms grown on drier and poorer soil the leaves become almost or entirely terete. On the other hand, the peculiar tribe of articulate *Junci* of the Pacific slope, which I have called *Ensifolii* from their characteristic sword-shaped leaves, exhibits, in alpine situations, such narrow leaves that they might inadvertently be mistaken for terete ones.

Inflorescence. — The inflorescence offers us important but, to a surprisingly great extent, variable characters. All *Junci* have, as is well known, a terminal inflorescence, even where it is seemingly lateral. In the Californian sub-genus *Juncellus*, and in a few South American and antarctic species which form the subgenus *Rostkovia* (gen. *Rostkovia*, Hook. f., *Rostkovia*, Desv., and *Marsippospermum*, Desv., in part), a single flower terminates the stem or scape; but all the true *Junci* have a more or less compound inflorescence of single flowers or of flowers crowded into larger or smaller heads.

In the inflorescence we observe numerous bracts, usually of a membranaceous texture; the uppermost bracts bear in their axils the flowers, which are always lateral, though in the species with single flowers they appear terminal. In these the lower of the two highest bracts, which are always found at the base of the flower, and which were therefore termed "calyx" by Rostkovius, bears the flower in its axil, the upper one remaining sterile; but the trace of an axillary product, an abortive flower or a leaf-bud, ought occasionally to be found, as is regularly the case in *J. pelocarpus*. In the single-flowered forms of this species the uppermost bract usually bears an abortive bud, or this bud grows out into a leafy branch, or it becomes a second flower; and then a third bract is formed, often

[1] Steudel, in his "Plantæ Glumaceæ," 1855, enumerates 196 species, many of them, however, undoubtedly nominal ones.

again with a leaf-bud, but never, so far as I know, with a third flower. Thus we have the complete transition from the single-flowered to the species in which the flowers are grouped into heads. In these each bract bears in its axil a flower, in centripetal succession, the uppermost minute bracts remaining sterile in the centre of the head.

The single-flowered *Juncí* bear panicles, or, as E. Meyer and many botanists after him called them, *anthelæ*, of different form and development. In some species (*e. g.* in the common forms of *J. tenuis* and *J. dichotomus*) the panicle has often the shape of an almost regularly dichotomous cyme, or at least the main branches are dichotomously divided; in most other species this regularity is considerably obscured by the development of many elongated branches from a short axis, which often almost seem to constitute an umbel, but which are mostly of very different [427] length, the lower ones being by far the longer. These rays or branches often repeat the development of the main axis several times, or are regularly dichotomously divided, or they assume the appearance of one-sided spikes with lateral inflorescence, somewhat after the fashion of the *Borragineæ*. A remarkable example of this is furnished by *J. tenuis*, var. *secundus*, which form also proves that this unilateral development of the inflorescence can by no means constitute specific distinction, as a series of intermediate forms are not wanting. We observe a similar condition in *J. Balticus* and the var. *Pacificus;* the Eastern form has the ordinary panicle, while that of the Pacific coast bears on the branches unilateral flowers.

In many others, and especially in all those that have knotted leaves, the flowers are arranged in heads. These heads consist of few, or are (often in *J. pelocarpus*) reduced to single flowers, or they bear a great many, and the different forms of the same species often vary immensely in this respect. Thus we find from 2 or 3 to 50 flowers in each head of the different forms of *J. pallescens*, 6 or 9 to 100 in the forms of *J. nodosus*, and 2 or 3 to 80 or 90 in *J. Canadensis*. These heads are single, or composed of several heads crowded together, when they appear lobed. I have seen the axis of the heads abnormally elongated, thus changing them into spikes 9–12 lines in length in three different species, all found in the southern States. In all of them the lower flowers seem to remain sterile, and only the uppermost ones bear fruit; or, after the earliest flowers have performed their functions, the axis, perhaps in a wet season, continues to grow and produces a second crop of flowers. *J. cylindricus*, Curtis, is such a spicate form of *J. marginatus;* I have also seen it in *J. pallescens*, var. *fraternus*, and most beautifully developed in *J. Canadensis*, var. *longicaudatus*. In this last specimen numerous rays form a rather compact almost level-topped umbel, and each ray bears a head of 3 to 5 or 6 sessile, diverging spikes. The heads are either single, terminating the stem like the head of an *Allium*, or they form a more or less compound inflorescence similar to that of the single flowers.

Flowers. — The flowers of these plants consist normally of 5 circles, each of 3 component parts; 3 outer and 3 inner perigonial leaves, which we call, on account of their herbaceous texture, sepals; 3 outer and 3 inner stamens and 3 carpellary leaves; each of the circles alternating with the next one, so that the 6 stamens stand before the 6 sepals, and the 3 carpels before the 3 outer sepals; but the 3 stigmas, as well as the valves of the capsule, before the 3 inner sepals. The third circle, consisting of the 3 inner stamens, is sometimes wanting. Only in one instance, in the only species of the sub-genus *Juncellus*, I find each circle consisting of two parts only, a curious [428] and rare arrangement in a monocotyledonous plant.

In place of flowers we find, in some species with articulate leaves, leafy buds or shoots as the result of retrograde metamorphosis, or as the morbid product of the oviposition of the *Livia Juncorum* or some allied insect. They are most common in *J. pelocarpus*, which, from this peculiarity, has been named *viviparus* and *abortivus;* in *J. pallescens*, var. *fraternus*, which therefore got the name *J. paradoxus*, and in *J. nodosus genuinus*.

Sepals. — The always persistent sepals furnish important characteristics. The exterior and interior ones are sometimes similar, but more frequently dissimilar; the former usually carinate or

naviculate, more herbaceous, more strongly ribbed and sharper pointed; the latter more delicate, with a wider membranaceous margin, flat or slightly concave, but not naviculate, and more frequently obtuse or only mucronate, but more variable in their outline than the exterior ones. The sets of sepals are either equal in length, or one exceeds the other, but neither their proportion nor the form of the inner sepals offers perfectly reliable characters in all species; in some they are more constant, while in others they vary considerably. In examining dried and even living specimens, the error of mistaking an involute sepal for an acute one must be avoided, — an error into which even careful botanists have sometimes fallen. The nerves of the sepals, which are of such diagnostic importance in *Graminœ* and even *Cyperaceæ*, are of minor value in *Junci*, as they vary considerably in different forms of the same species.

Stamens. — E. Meyer had already paid attention to the number of stamens and their proportion, and in many species valuable characters are derived from them, but they alone cannot constitute specific distinction. They are generally persistent, which permits us to examine them in all stages of development of the flower and fruit; only in *J. Smithii* and in *J. Rœmerianus* the anthers fall away early and the filaments only persist. The number of stamens is normally six, but in many (principally American) species, it is, by suppression of the inner circle, reduced to three; those three stamens stand, therefore, before the outer sepals and at the angles of the ovary or capsule. We have only two species in which their number regularly varies between three and six, *J. Buckleyi* and *J. caudatus;* in them the inner circle of stamens is incompletely present. In many triandrous species we find occasionally a fourth or fifth stamen, and that often smaller than the rest; but where both circles are regularly developed, I have never seen them unequal in size or shape, which we notice so often in other allied families.

The proportion of stamens and sepals, and of anthers and filaments, is often very con- [429] stant, but in some species they vary very much, as may be seen in *J. scirpoides*, the different forms of which bear stamens of different length and anthers of different size, without exhibiting other characters of sufficient specific value.

In a rare form of *J. Rœmerianus* I find both circles of stamens suppressed or rather undeveloped and in a rudimentary state, so that those plants become unisexual. Corresponding male plants may perhaps yet be discovered.

Filaments are always present; in some species they are very short, in others elongated, in all dilated at base, and, at least in the hexandrous ones, more or less united. Their base, which in the young flower adheres to the base of the pistil, after fecundation remains attached to the base of the sepals.

The shape of the anthers is of slight importance; they are longer or shorter, linear or oblong, in some species pointed or cuspidate, in most others obtuse or emarginate, more or less sagittate at base; but these characters show little constancy.

Pistil. — The pistil exhibits great differences in its form, and furnishes good and generally constant characters. The ovary is obtuse or acute, gradually or abruptly elongated into the style. This organ is often very short, but in many species it has the length of the ovary, or even exceeds it; in a few species only it is variable, *e. g.* in *J. scirpoides*, which in this as in most other organs offers a degree of variability scarcely seen in any other species. The stigmas are longer or shorter than the ovary with the style, always (except in *Juncellus*) three in number, very slender and more or less twisted; in *J. acutus* they are short and thick, and in *J. stygius*, as already Linnæus remarks, short and recurved. In just expanding flowers the length of the stamens is often equal to that of the ovary and style together, so that the stigmas only emerge from between the anthers, or they are equal to the ovary alone, when the whole style with the stigmas protrudes over the anthers.

Capsule. — The capsule is diagnostically one of the most important organs in *Junci*. It varies from globose to ovate, obovate, prismatic, pyramidal or subulate, terete or angular, retuse, obtuse or

acute, mucronate or rostrate; it is shorter or longer than the sepals or equal to them; but all these characters vary within certain limits, in some species more than in others, and only the examination of a large number of specimens can decide about their constancy and value in a given species. The capsule is always three-valved (excepting again *Juncellus*), opening into the cells, the valves bearing on their median line the placentæ either immediately (parietal placentæ and one- [430] celled capsule) or on a fold which extends to the centre and forms the dissepiments (central placentæ and three-celled capsule); shorter dissepiments make semi-trilocular capsules. Very fragile dissepiments, which break off when the capsule opens, leaving the placentæ central and detached (septifragal dehiscence), are found in *J. repens* (therefore generically distinguished by Desvaux), and to some extent also in *J. Parryi, J. patens,* and *J. setaceus.* The placentæ of *J. Rœmerianus* are enormously developed into a spongy mass, which fills the greater part of the capsular cavity.

The capsule opens almost always from top to the middle or to the base; only in some of our species with subulate capsules (*J. scirpoides, J. nodosus*) the separation of the valves commences in the middle, while at the top they remain united for some time.

Seeds. — The seeds, when perfectly ripe, furnish some of the most interesting and constant characters, but they are so small and their markings so delicate that only a strong glass, or, better, a microscope with a magnifying power of fifty or sixty diameters, will properly exhibit them. It may not be useless to caution botanists not to be deceived by seeds loosely lying about with the specimens, as they very often will be found mixed.

The seeds are ascending or (the elongated ones) more or less erect, with a lower end at the insertion of the funiculus and an upper one at the chalaza, both ends united by the rhaphe and often by a distinct fold of the testa. The seeds are usually obovate or oblanceolate, thicker at the upper than at the lower end, mostly terete, or, in rare cases (*J. trifidus*), angular, when a few large seeds are pressed upon one another. The ends are sometimes obtuse (*J. bufonius*), but commonly either abruptly or more gradually pointed, apiculate or even fusiform (*J. pallescens, nodosus, scirpoides*). Very frequently the testa is slightly elongated beyond both ends of the body of the seed and forms a small, membranaceous appendage (*J. effusus, tenuis, marginatus*); in such seeds the longitudinal fold of the testa, mentioned above, also becomes more distinct. In many and apparently more in American and in alpine or arctic species (*J. Drummondii, Greenii, Canadensis,* etc.) these appendages become more conspicuous, and extend beyond the seed itself as empty, shrivelled, tail-like, white, or, rarely, reddish sacs. Such seeds have been called scobiform; their seed-coat is more loosely adhering and sometimes (*J. stygius*) can be readily removed. This elongation of the testa is of great diagnostic value, but the absolute or proportionate length of the appendages is extremely variable; even in the same capsule I find the lower seeds with shorter tails than the upper ones, and in *J. Canadensis* we see forms with such different length of tail that only the absence of [431] any other diagnostic characters can induce us to consider them as belonging to one and the same species. Much less can generic distinction be based upon this character, as was done by Desvaux, who comprised in his genus *Marsippospermum* all *Junci* with tailed seeds. Even E. Meyer's (in Synopsis Juncorum, 1822, and in Ledebour's Flora Rossica, 1853) separation of the species with tailless seeds as a second section is unnatural, as not only tail-seeded kinds are found in all the great groups, but also species with intermediate seeds exist, which it would be difficult enough to place properly. R. Brown (Prod. Nov. Holl., p. 258) settles the whole question in the following pithy sentence: *Nec secernendæ sunt eæ quæ seminibus gaudent scobiformibus, testa nempe, quæ in pluribus utrinque laxa, in hisce valde elongata.*

The size of the seed varies from 0.1 to 2.0 lines in length, it mostly ranges between 0.2 and 0.3 lines, and rarely reaches 0.4 lines; the tailed seeds are usually larger than the others, averaging from 0.5 to 2.0 lines in length; even without the appendage, *J. trifidus* has the body of the seeds of 0.5, *J. castaneus* of 0.5–0.6, and *J. stygius* of 0.7–0.8 line in length.

The delicate markings of the seeds are so various, and in the same species so constant, that it will be useful to dwell a little longer on them. Their surface appears never quite, and rarely nearly, smooth, when magnified fifty or sixty times. We can almost always discover longitudinal ribs, more or less close together, from 8 or 12 to 30 or 40 or more around the seed; as it is difficult to count the ribs all around these small bodies, and as an approximate designation is quite sufficient, only the number visible on one side may be counted. These ribs are very marked, sharply elevated, in *J. marginatus* (*semina costata*), or they are reduced to more delicate lines in *J. Canadensis* and most tail-seeded species (*semina multicostata* and *striato-costata*). These ribs or lines are usually united by very delicate transverse lines (*lineolæ*), when such seeds may be termed *costato-lineolata*, or by fewer and more prominent cross-bars: *semina costato-reticulata*.

When the ribs are fewer and wider apart, and united by transverse ridges so as to form somewhat rectangular meshes, I call the seeds *semina reticulata*. The area of these meshes is sometimes quite smooth (*J. militaris*), or crossed with very few transverse or longitudinal lines (*J. scirpoides*): *semina areis lævibus reticulata;* or it is distinctly marked by numerous delicate transverse lines, sometimes, also, with one or two perpendicular lines: *semina areis lineolatis reticulata*. In very few instances I find an irregular and indistinct reticulation: *semina irregulariter sub-reticulata*.

A large number of *Junci* exhibit a very delicate but regular transverse reticulation without (in fully ripe seeds) very distinct ribs: *semina lineolata*. In some species the [432] marks are coarser, in others more delicate.

We divide the seeds, then, into *semina reticulata, lineolata,* and *costata;* to both the former belong the tailless, to the latter the tailed seeds.

I arrange all the species, the seeds of which I have been able to study, according to their surface markings, in the following table. Our species are in italics, the foreign ones in Roman type:—

I. SEMINA RETICULATA, vix seu distincte apiculata.

1. Semina levissime irregulariter reticulata seu læviuscula, non costata nec lineolata. *Omnes e Juncorum genuinorum sectione.*
   J. Pacificus, compressus, filiformis, Smithii.
2. Semina regulariter reticulata, areis lævibus seu levissime longitudinaliter lineolatis. *Nostrates e Juncorum articulatorum sectione, pauci exotici graminifolii.*
   J. militaris, Elliottii, scirpoides, phæocephalus; J. Tasmanicus,[2] squarrosus, capitatus.
3. Semina regulariter reticulata, areis tenuiter transverse lineolatis. *Omnes ad J. articulatos pertinent.*
   J. pelocarpus, articulatus, alpinus, pallescens, Bolanderi, brachycarpus, nodosus, xiphioides, Mertensianus; J. sylvaticus, atratus, obtusiflorus, microcephalus, oxycarpus, supinus, Leschenaultii.

II. SEMINA TRANSVERSE LINEOLATA, levissime costata; vix seu distincte apiculata seu breviter caudata.

1. Semina areis latioribus fere transverse reticulata. *E. Juncorum genuinorum et graminifoliorum sectionibus.*
   J. Balticus, setaceus, dichotomus.
2. Semina areis angustissimis transverse lineolata. *E. Juncorum genuinorum et graminifoliorum sectionibus et Juncelli species unica.*
   J. effusus, patens, tenuis, Gerardi, bufonius, repens, saginoides; J. glaucus, pauciflorus, bulbosus.

III. SEMINA COSTATA, plus minus caudata.

1. Semina inter costas plerumque pauciores conspicuas lineolata; apiculata seu breviter caudata. *E. Juncorum genuinorum et graminifoliorum sectionibus.*
   J. Ræmerianus, acutus, marginatus, longistylis, Buckleyi; J. maritimus.
2. Semina inter costas plures distincte reticulata; apiculata seu plus minus caudata. *Ex omnibus Juncorum sectionibus.*
   J. arcticus, Drummondii, Hallii, biglumis, Greenii, Canadensis, var. *sub-caudatus*.
3. Semina inter costas numerosissimas tenues seu tenuissimas transverse lineolata seu lævia; caudata. *Ex omnibus Juncorum sectionibus.*
   J. Parryi, Vaseyi, triglumis, castaneus, stygius, trifidus, Canadensis, caudatus, asper; J. Jacquini.

It will be observed that in this arrangement some forms which I consider as belonging to one specific type had to be separated; thus, the Pacific form has been removed from *J. Balticus*, and the

[2] The Tasmanian *J. falcatus*, which I consider a distinct species.

sub-caudate variety from *J. Canadensis*, proving that differences in the surface or in the shape of the seed alone are not sufficient to establish specific distinction.

What constitutes a Species. — The specific character lies not in any single organ of the [433] plant, however essential it may be; only sufficient and corresponding differences in a series of organs can authorize us to recognize specific distinction. But as such discrimination is of course left to individual judgment, different investigators will arrive at different conclusions. Some species, to be sure, vary very little, and will by every botanist be recognized as distinct from all others, and as indivisible; such are, e. g., *J. filiformis*, *J. militaris*, *J. stygius*, *J. repens*; but other species exercise the botanists considerably, some forms being held distinct by some, while they are united by others; such are, among our species, especially *J. pallescens*, *J. scirpoides*, *J. nodosus*, and *J. Canadensis*, all belonging to the group *Articulati*. I have no doubt that some botanists, especially such as have not the means of comparing the bewildering quantity of transition forms now before me, will find my views in this respect too contracted, but careful investigation in the field will, I trust, bear me out.

After these preliminary remarks I submit a list of our North American *Junci* and their principal varieties, as I understand them, followed by an account of their geographical distribution.

Systematic Arrangement.

GENUS JUNCUS, *Linn.*

Sub-genus I. JUNCUS.

I. Junci genuini, caule aphyllo basi vaginis aphyllis seu rarius folia ipso cauli similia gerentibus stipato.

A. Glomeruliflori.

1. *J. acutus*, Linn., California, New Jersey (?).
2. *J. Rœmerianus*, Scheele (J. maritimus, Auct. Am.), New Jersey to Texas.

B. Singuliflori.

a. Pluriflori, panicula plus minus composita.

α. Robustiores, capsulis ovatis seu obovatis.

1. Foliiferi.

3. *J. compressus*, H.B.K., California, Mexico.

2. Aphylli.

* Hexandri.

4. *J. Breweri*, n. sp., California.
5. *J. Balticus*, Dethard.
   β. *littoralis*, coast of New England to the Mississippi.
   γ. *montanus*, western deserts and Rocky Mountains.
   Sub-species *J. Pacificus*, Pacific coast.

* * Triandri.

6. *J. procerus*, E. Mey. (?), California.
7. *J. effusus*, Linn., over the whole country.[3]

β. Graciliores, floribus plerumque paucioribus, sæpe viridulis, sepalis fructiferis sæpe patentibus, capsula subglobosa.

1. Aphylli.

8. *J. patens*, E. Mey., California.
9. *J. filiformis*, Linn., northward.

2. Foliiferi.

10. *J. Smithii*, n. sp., Pennsylvania.
11. *J. setaceus*, Rostk., Virginia to Louisiana.

b. Pauciflori, panicula vix usquam composita.

α. Apiculati.

12. *J. arcticus*, Willd., Greenland.
    Sub-sp. *J. Sitchensis*, northwestern coast.

β. Caudati.

1. Aphylli.

13. *J. Drummondii*, E. Mey., Rocky Mountains and northwestward.

2. Foliiferi.

14. *J. Hallii*, n. sp., Colorado.
15. *J. Parryi*, n. sp., Rocky Mountains, and mountains of California and Oregon.

Maritimi. — 1, 2

Communes. — 3, 4, 5, 6, 7, 8, 9, 10, 11

Arctici. — 12, 13, 14, 15

[3] The triandrous *J. Pylæi*, La Harpe, which is entirely unknown to me, seems to belong here, or near *J. arcticus*.

II. JUNCI GRAMINIFOLII, caule nudo seu foliato; foliis planis seu semiteretibus canaliculatis seu raro subteretibus.

A. Macrospermi, alpini, seminibus paucis magnis caudatis, foliis fistulosis.

a. Pauciflori.

16. *J. trifidus*, Linn., northeastern mountains.
17. *J. biglumis*, Linn., Arctic regions.

b. Capitellati.

18. *J. triglumis*, Linn., Rocky Mountains to Arctic regions.
19. *J. stygius*, Linn., western New York to Maine and New Brunswick.
20. *J. castaneus*, Smith, Rocky Mountains to Arctic regions.

ALPINI.

B. Singuliflori.

a. Simplices, nudicaules, erecti.

α. Caudati.

21. *J. Vaseyi*, n. sp., Lake Michigan to Colorado.
22. *J. Greenii*, Oakes & Tuck., New England.

β. Apiculati.

23. *J. tenuis*, Willd.
    - α. *communis*, all over the country.
    - β. *secundus*, Pennsylvania to New England.
    - γ. *congestus*, California.
24. *J. dichotomus*, Ell., District of Columbia to Louisiana.
25. *J. Gerardi*, Lois., eastern sea and lake coasts, and salines.

b. Ramosi, caulophylli, diffusi.

26. *J. bufonius*, Linn., all over the country.

TENUES.

C. Glomeruliflori.

* Hexandri (No. 30, 3–6-andrus).

27. *J. repens*, Michx., Maryland to Louisiana.
28. *J. falcatus*, E. Mey., Pacific coast.
29. *J. longistylis*, Torr., Rocky Mountains and northwestward.
30. *J. leptocaulis*, Torr. & Gray (J. filipednulus, Buckl.), Texas.

* * Triandri.

31. *J. marginatus*, Rostk., Atlantic and central States to Texas.

GRAMINEI.

III. JUNCI ARTICULATI, caule folioso; foliis septis transversis interceptis inde nodoso-articulatis.

A. Articulati veri, foliis teretibus seu leviter (in No. 40 var. forte) tereti-compressis.

a. Apiculati.

1. Sub-singuliflori.

32. *J. pelocarpus*, E. Mey. (J. Conradi, Tuck.), Newfoundland to South Carolina, and along the great Lakes.
    - β. *crassicaulis* (J. abortivus, Chapm.), Florida.
    - γ. (?). *subtilis*, Canada.

2. Pauciflori (No. 37, var. δ, ad multifloros accedens).

* Hexandri.

33. *J. articulatus*, Linn., northern New York and New England.
34. *J. alpinus*, Vill. (J. pelocarpus, Gray), northwestern New York to the Rocky Mountains and the Arctic regions.
35. *J. militaris*, Bigelow, New England and southward.

* * Triandri.

36. *J. Elliottii*, Chapm., North Carolina to Florida and Alabama.
37. *J. pallescens*, Lam.
    - α. *diffusissimus*, Texas.
    - β. *debilis* (J. acuminatus, Mx.), middle and southern States east of the Mississippi.
    - γ. *robustus*, Mississippi valley from Illinois to Louisiana.
    - δ. *fraternus* (J. paradoxus, Mey.), Michigan and Massachusetts to the Rio Grande.

3. Multiflori.

* Triandri.

38. *J. brachycarpus*, n. sp., Mississippi valley and to the Rio Grande.
39. *J. Bolanderi*, n. sp., California.
40. *J. scirpoides*, Lam.
    - α. *macrostemon*.
        - A. *macrostylus*, South Carolina to Texas.
        - B. *brachystylus*, New Jersey to Arkansas and Texas.
    - β. *brachystemon*.
        - A. *echinatus*, Maryland to Florida and Texas.
        - B. *gladiatus*, North Carolina to Arkansas and Texas.

* * Hexandri.

41. *J. nodosus*, Linn.
    - α. *genuinus*, Pennsylvania to Canada and to the northwest coast.
    - β. *Texanus*, Texas.
    - γ. *megacephalus*, western New York, southwestward to Texas and California.

ARTICULATI.

b. Caudati.

* Hexandri (No. 43, 3–6-andrus).

42. *J. asper*, n. sp., New Jersey.
43. *J. caudatus*, Chapm., South Carolina to Florida and Louisiana.

* * Triandri.

44. *J. Canadensis*, Gay.
    - α. *brevicaudatus* (J. acuminatus, Gray).
        - A. *coarctatus*, Pennsylvania, northward and northwestward.
        - B. *patulus*, Pennsylvania to western New York and Ohio.
    - β. *subcaudatus*, Connecticut to Georgia.
    - γ. *longicaudatus* (J. paradoxus, Gray), Massachusetts southward to Louisiana, and northwestward to Minnesota.

CAUDATI.

B. Ensifolii, foliis iridaceis compressis equitantibus.

45. *J. Mertensianus*, Bong., Rocky Mountains northwestward to the coast.
46. *J. xiphioides*, E. Mey.
    - α. *auratus*, California.
    - β. *littoralis*, California.
    - γ. *montanus*, Rocky Mountains and eastward into the plains.
    - δ. *macranthus*, Oregon and to the northwest coast.
    - ε. *triandrus* (J. ensifolius, Wick.), California to Unalaschka.
47. *J. oxymeris*, n. sp., California.
48. *J. phæocephalus*, n. sp., California.
49. *J. chlorocephalus*, n. sp., California.

ENSIFOLII.

SUB-GENUS II. JUNCELLUS.

50. *J. saginoides*, n. sp., California.

JUNCELLUS.

GEOGRAPHICAL DISTRIBUTION.

Of the fifty species above enumerated, thirty-three, or two-thirds, are peculiar to our [437] country, and seventeen, or one-third, occur also in other parts of the world. Two of these seventeen (*J. effusus* and *bufonius*) are cosmopolitan species, which are found in almost all countries of our globe; six (*J. arcticus, trifidus, biglumis, triglumis, stygius*, and *castaneus*) are alpine or arctic forms, which also inhabit appropriate localities in the old world; three (*J. acutus, Balticus*, and *Gerardi*) grow principally near salt water, and also occur in Europe, and the former, also, in Africa and South America; three others (*J. filiformis, articulatus*, and *alpinus*) make their home in the northern parts of the northern hemisphere; one (*J. tenuis*) is also found in middle America and western Europe; and two extend southward over our limits, *J. compressus* into Mexico, and *J. procerus*, if our plant is correctly referred, to Chili.

The different forms of *J. Balticus, nodosus*, and *Canadensis*, grow in different regions. The eastern and northern *J. Balticus* is distinct from the form of the interior plains, and very much so from that of the Pacific coast; the Texan form of *J. nodosus* is very different from the northern one, and that of the western States and Territories is quite unlike the others; *J. Canadensis* has a northern, an eastern, and a third form, which is more generally distributed.

None of the eight southern species are found anywhere else, and of the nine Pacific species only the two above mentioned extend beyond our territory to other parts of America, adding another proof of the well-known fact, that of all our Floras that of the southern and that of the Pacific States are the most peculiar and exclusive ones.

From their geographical distribution our species may be arranged thus: —

1. Over the whole country grow *J. effusus, tenuis, bufonius*, and *nodosus*. Of these only the last one does not extend into other Floras.

2. Over the whole country, with the exception of the western plains and mountains, and the Pacific slope: *J. marginatus* and *pallescens*, both peculiarly North American.

3. Over the whole country, with the exception of the great interior valley and the Pacific region: *J. pelocarpus* and *Canadensis*, both only found in North America.

4. In the great interior valley from Michigan to the Rio Grande: *J. brachycarpus*, and, with more extensive limits, one of the forms of *J. nodosus* (the var. *megacephalus*).

5. Northward: *J. filiformis* and the northern varieties of *J. nodosus* and *Canadensis;* northeastward: *J. articulatus, Greenii,* and, very locally, *J. Smithii;* northwestward, extending [438] to the Rocky Mountains: *J. alpinus* and *Vaseyi.*

6. Southward, mostly southeastward and to the Gulf, some of the species extending southwestwardly to Arkansas and Texas: *J. setaceus, dichotomus, repens, Elliottii, scirpoides, caudatus,* and *asper*, the latter only in the most northeastern limits of the region; *J. scirpoides* as far north and southwest as any of these species; southwestward: *J. leptocaulis* and a form of *J. nodosus* (the var. *Texanus*).

7. On the Pacific slope, in the low country: *J. compressus, Breweri, patens, arcticus* (var.), *Bolanderi,* and *oxymeris.* The following extend from the coast to the mountains: *J. Mertensianus, xiphioides,* and *phæocephalus*, the two former spreading eastward to and beyond the Rocky Mountains.

8. Maritime species, — northeast: *J. Balticus, Gerardi,* and *militaris,* the two former extending inland along the lakes, the two latter also southward; southeast: *J. Rœmerianus;* Pacific coast: *J. acutus, procerus, Balticus,* subspecies, and *falcatus.*

9. Alpine and arctic species, — eastern: *J. arcticus, trifidus,* and *stygius;* western: *J. Drummondii, Hallii, Parryi, triglumis, castaneus, longistylis, chlorocephalus, saginoides,* — the two last only on the Californian Alps. *J. biglumis* has been found thus far solely in the highest arctic regions of our continent.

The following table exhibits at a glance the geographical distribution of our species: —

	Peculiar to our country.	Common with other countries.	Total.
1. Whole country	1	3	4
2. Whole country except Pacific region	2	..	2
3. Whole country except Pacific region and Mississippi valley	2	..	2
4. Interior valley	1	..	1
5. Northward	3	3	6
6. Southward	8	..	8
7. Pacific slope	7	1	8
8. Maritime species	3	4	7
9. Alpine and arctic species	6	6	12
Total	33	17	50

NOTES ON THE NORTH AMERICAN SPECIES OF JUNCUS.

1. J. ACUTUS, Linn., has been found by Prof. Brewer near San Luis Obispo, California, "where it is abundant in a stream in the hills between the town and the landing of the same name, a few miles from the sea, growing in dense tufts." His specimens were collected in April in full bloom; the stem is nearly four feet high, the pan- [439] icle six inches long; the flowers, absolutely identical with European specimens, are easily recognized by their broadly margined sepals, the inner ones being deeply emarginate, and by their thick and short subulate stigmas. I have also seen specimens said to have come from the coast of New Jersey; Baldwin collected it on the La Plata in South America, and Chamisso and Gaudichaud brought it from the same regions. *J. macrocarpus,* Nees, from the Cape of Good Hope, is the same species.

2. J. RŒMERIANUS, Scheele, Linnæa, 22, 348; Walp. Ann. 3, 655: rhizomate longe repente; foliis caules (2–3 pedales) robustos rigidos teretes æquantibus; spatha paniculam supra-decompositam patulo-effusam longe superante; glomerulis 3–5-floris; sepalis ovato-lanceolatis 5-nerviis exterioribus acutatis, interioribus brevioribus obtusis sæpe

mucronatis ; antheris sex late linearibus filamento ter quaterve longioribus demum deciduis ; stylo ovario ovato multo breviore ; capsula ovata obtusa mucronulata sepala exteriora æquante placentis tumidis triloculari ; seminibus late obovatis obtusis vix apiculatis tenuissime (sub lente) costato lineolatis (*J. maritimus*, auct. Amer.).

Atlantic coast of the United States from New Jersey to Florida and Texas. — Closely allied to the European *J. maritimus*, for which it has always been taken, until Scheele, without discovering its distinctive characters, gave it a new name. It is well marked by an open spreading panicle with slender flexible branches; deciduous anthers; a very short style, which is not half as long as the obtuse ovary ; an obtuse, short, deep brown capsule ; remarkably large, spongy placentæ, which fill the greater space of the capsular cavity, and the like of which I have not seen in any other species ; and obtuse, tailless seeds, marked with very slight wavy ribs and slighter cross lines. — *J. maritimus* bears a rigid, fastigiate panicle, persistent anthers, an ovary attenuated into a style of nearly its own length, a greenish, acute capsule which usually exceeds the sepals, placentæ of ordinary size, and seeds with distinct tails and stronger ribs. The light brownish flowers are 1.5 lines, and the seeds 0.3 line long, and nearly 0.2 line thick.

This is the only *Juncus* in which occasionally unisexual specimens occur (Georgia, Le Conte, in Hb. Acad. Philad., and Florida, Chapman, in Hb. A. Gray); these plants, pistillate by abortion of the stamens, have a stricter but fewer flowered panicle, and thus present a very unusual aspect ; our southern botanists ought to find out under which conditions this form occurs, and whether any corresponding staminate plants grow with them.

3. J. COMPRESSUS, H. B. K. nov. gen. 1, 235 ; Kunth, Enum. 3, 317: rhizomate repente, caulibus (pal- [440]
maribus sesquipedalibus) compressis farctis siccis tenuiter striatis ; vaginis aphyllis muticis seu sæpius folia
culmo simillima breviora gerentibus; spatha paniculam compositam seu decompositam ad ultimos ramos secundifloram æquante seu superante ; sepalis lanceolatis, exterioribus acutis seu subulato-acutatis, interioribus paulo brevioribus obtusiusculis stamina sex dimida seu tertia parte superantibus ; antheris late linearibus filamento brevi multo (quadruplo quintuplo) longioribus ; stigmatibus ovarium cum stylo fere æquilongo subæquantibus; capsula ovata acuta (inclusa ?) triloculari ; seminibus ovatis obtusis vix apiculatis læviusculis.

Salinas valley, in sandy river bottoms, May 1, in flower ; Calif. State Survey No. 529, the only locality in our flora known to me. Dr. J. Gregg collected the same species in northern Mexico ; smaller forms, eight inches high, with very short spathe, and a stouter one, 12–18 inches high, with longer spathe and larger panicle. The Californian specimens are 10–15 inches high, with a spathe 2–4 inches long; panicle small, rather simple, only the extreme branchlets with one-sided flowers ; the reddish streaks on the sepals very pale; the only capsule seen (not ripe) was shorter than the sepals and contained a few large seeds, 0.37 line long and apparently very slightly lineolate. — This plant is evidently closely allied to *J. Balticus ;* it bears very similar but paler flowers, with the same stout anthers on very short filaments ; but the flattened stem and the frequent occurrence of leaves distinguish it. Among Fendler's Sante Fé plants, however, I find under No. 860, with the legitimate *J. Balticus*, var. *montanus*, small specimens 6–7 inches high, with the darker flowers of the former, but with a slightly compressed stem, and occasionally with a leaf from the vaginæ. Is that a form intermediate between and connecting both species ?

4. J. BREWERI, n. sp. : rhizomate perpendiculari; caulibus cæspitosis (pedalibus) compressis lævibus farctis ; vaginis nervosis muticis ; spatha paniculam paucifloram in ultimis ramis secundam longe superante ; sepalis subæqualibus ovatis late marginatis abrupte acuminatis ; antheris late linearibus filamento brevi multo (quadruplo quintuplo) longioribus ; stigmatibus ovarium cum stylo æquilongo æquantibus exsertis ; capsula . . . .

Wet, sandy soil, near Monterey, California, the same unfortunate locality that has so often been confounded by botanical writers with Monterey in Nuevo Leon, Real del Monte in Mexico, and even Montreal in Canada ; Calif. State Survey No. 651, in flower in the latter part of May. — The perpendicular rhizoma (if a constant character) and the strongly compressed stem, together with the broad and abruptly acuminate sepals, distinguish it from [441]
the smaller forms of *J. Balticus*, the absence of leaves and the form of the sepals from *J. compressus*, with both of which it is closely allied by the form of the stamens, so different from those of any other American or European *Juncus* of this section. — Stems a foot high, four or five inches of which belong to the spathe ; inflorescence small, rather compact ; flowers $2\frac{1}{2}$ lines long ; sepals dark brown, greenish in the middle, membranaceous on margin. — I have named this plant for Prof. Wm. H. Brewer, in acknowledgment of his services in the cause of science in California.

5. J. BALTICUS, Dethard. ap. Willd., is well characterized by its long and large anthers, which it has in common only with the two last-mentioned species, and its terete stem and leafless vaginæ. Originally found on the shores of the Baltic, it has been traced to those of northwestern Europe and to our northeastern coasts from Newfoundland to Massachusetts ; but here it leaves its seaside home and appears in several swamps in Lancaster county in the interior of Pennsylvania ; all along the great lakes it is a common plant, not unexpected, to be sure, as on their shores we meet with many other marine plants, such as *Cakile, Lathyrus maritimus, Euphorbia polygonifolia*, and others, while they are quite free from saline matter. Is it the ocean-like spray of the waves of these immense bodies of fresh water, is it the ever-varying sand-formation of the downs, which invites sea-strand plants, or are they the remnants of an ocean-

coast vegetation left from a period when the beds of these lakes were filled by an immense arm of the sea? Be that as it may, our species is not confined by the line of the lakes, but appears again on the upper Mississippi and St. Peters rivers, hence northwestward into the British possessions, and westward to the Mauvaises Terres and to the head waters of the Missouri, and then southward along the Rocky Mountains to Colorado and New Mexico, and farther west to the Cascade Mountains in Oregon. We find it again as a true maritime plant on the Pacific coast from the northern Russian islands to California and in Chili. This Pacific form is so different from the others that some will regard it as a distinct type. The different forms may be thus characterized: —

J. Balticus genuinus: caulibus tenuioribus rigidis farctis; paniculæ laxioris ramis dichotomis; floribus minoribus; capsula obtusa mucronata; seminibus grosse lineolatis.

Var. *α. Europæus:* sepalis exterioribus acutioribus longioribus capsulam late ovatam obtusam mucronulatam subæquantibus; antheris minoribus filamento duplo longioribus; seminibus ovatis obtusis brevissime apiculatis. — Northern Europe.

Var. *β. littoralis:* sepalis ut in Europæo capsulam angustiorem acutius angulatam longius mucronatam æquantibus; antheris majoribus filamento brevissimo quadruplo longioribus; seminibus ut in Europæo. — Atlantic coast to the upper Mississippi.

Var. *γ. montanus:* sepalis fere æquilongis æqualibus seu interioribus obtusioribus; antheris ut in littorali; capsula ovato-pyramidata angulata rostrata; seminibus minoribus angustioribus longius apiculatis. — Western plains and mountains.

Sub-sp. *J. Pacificus:* caulibus crassioribus mollioribus sæpe fistulosis; paniculæ densifloræ ramis secundis; floribus majoribus; sepalis exterioribus acutissimis interiora obtusa paulo superantibus capsulam ovatam acutam mucronatam subæquantibus; antheris majoribus filamento brevissimo quadruplo quintuplo longioribus; seminibus magnis ovatis obtusis breviter seu vix apiculatis tenuissime irregulariter reticulatis seu lævisculis. — *J. Lesueurii*, Bolander in Proc. Ac. Calif. 2, 179. *J. Balticus*, Benth. Pl. Hartw. p. 341. *J. compressus*, E. Mey. Pl. Chamisso in Linn. 3, 368, planta Chilensis. — *J. Hœnkei*, E. Mey. Syn. Junc. p. 10, forma borealis pauciflora.

6. J. PROCERUS, E. Mey.? Linn. 3, 367; Kunth, En. 3, 322: culmo erecto elato (tripedali) tereti striato farcto basi vaginis atrofuscis obtusis breviter aristatis stipato; spatha paniculam decompositam densifloram multiradiatam corymbiformem longe superante; sepalis æquilongis lanceolatis, exterioribus acutato-subulatis, interioribus obtusis mucronatis capsulam ovatam subacutam trilocularem æquantibus; staminibus 3 sepalis quarto parte brevioribus antheris linearibus filamento paulo longioribus; seminibus majusculis ovatis.

In brackish marshes, San Francisco, Cal., *H. Bolander*. — In its technical character, especially in the form of the sepals and the capsule, this plant corresponds well with Meyer's Chilian species, but a specimen in the royal herbarium at Berlin, brought from Chili by D'Urville, has much smaller flowers, a more compound, loose-flowered panicle; smaller flowers, and smaller, narrow, long-apiculate, finely lineolate seeds, and is in all respects similar to *J. effusus*, with the exception of the inner sepals and the capsule. But unwilling to give a new name to a plant so incompletely known, I provisionally refer this Californian to the Chilian species; I suggest, however, the possibility of the Californian plant being a hybrid between *J. effusus* and *J. Pacificus*, which both occur in its neighborhood; it seems that only very few and imperfect seeds can be found in the otherwise well developed specimens now before me, [443] and that in size and form these seeds, as well as the flowers, anthers, and capsules, are intermediate between those of the supposed parents, while the number of stamens is that of *J. effusus*. The panicle is remarkably compact and consists of 10–15 secondary branches of nearly equal length.

7. J. EFFUSUS, Linn., is found from Maine to the Rio Grande and to the Pacific, but is wanting in some districts. It has *always* three stamens, the small anthers of which are of nearly equal length with the filaments. The most prominent and very constant character consists in the number of stamens and in the obovate or even clavate, upwards almost tricoccous, *retuse* capsule; seeds apiculate and finely lineolate.

8. J. PATENS, E. Mey. Syn. Luzul. p. 28; Rel. Hænk. 1. 141; Kunth, En. 3, 318. *J. compressus*, E. Mey. Syn. Junc, p. 16, non H. B. K. This very distinct species seems not to have fallen under the observation of botanists since, about seventy years ago, Hænke discovered it near Monterey, Cal., until Mr. Bolander and Prof. Brewer again obtained it near San Francisco and in the Santa Lucia Mountains of that State. Meyer's description in Rel. Hænk. l. c. is so complete that very little can be added. I find, however, the densely cespitose, slender, but wiry stems not compressed but terete, and distinctly striate; they are 15 inches to 2½ and 3 feet high including the spathe, which has a length of 3 or 4 to 8 or 10 inches; their base is enclosed by elongated sheaths, brownish-red below and greenish straw-colored upwards, tipped with a conspicuous awn; the panicle, 1–2 inches long, consists of 3–5 larger branches, with the ultimate branchlets one-sided, spreading, or recurved, whence the specific name. The flowers are not quite as large as those of *J. Balticus*, and much lighter colored; sepals lanceolate, acute, exterior ones subulate at tip, equalling, or slightly exceeding, the inner ones, spreading in fruit; stamens about half the length of the sepals, and anthers nearly equal to the filaments; ovary with the short style about the length of the stigmas. The subglobose,

mucronate capsule, a little shorter than the sepals, opens with septifragal dehiscence, the three placentæ with their membranaceous wings, remnants of the dissepiments, remaining in the centre. The very numerous seeds are ovate, obtuse, usually oblique, obliquely apiculate, delicately lineolate, 0.22–0.30 lines long.

9. J. FILIFORMIS, Linn., which was formerly often taken for *J. setaceus* by American botanists, extends from Oneida Lake in western New York to the White Mountains in New Hampshire, and to Maine, is common in Lower Canada and in the Hudson Bay region, and has also been found from the northern Rocky Mountains to the Cascade Mountains. The American specimens are in nowise different from the European ones; the seeds are [444] obovate, strongly apiculate, with a very distinct rhaphe, and are irregularly and rather indistinctly reticulated.

10. J. SMITHII, n. sp.: rhizomate? vaginis? foliis? caulibus bipedalibus teretibus farctis siccis striulatis; paniculæ laxæ subsimplicis paucifloræ spatha longissima; sepalis æquilongis, exterioribus acutatis, interioribus obtusis; staminibus 6; capsulæ exsertæ subglobosæ acutæ mucronatæ (fuscatæ) trilocularis dissepimentis tenuissimis fragilibus; seminibus magnis obovato-oblongis obtusis vix apiculatis irregulariter reticulatis.

Pennsylvania, in a sphagnous swamp on Broad Mountain near Pottsville, Schuylkill county, where *Mr. Charles E. Smith*, of Philadelphia, for whom this species is named (*J. Smithii*, Kunth, is the English *J. tenuis*), discovered it in June, 1865, with nearly ripe fruit, and where he expects to obtain more complete specimens in the coming season, as it grows in a very accessible, but thus far little explored part of Pennsylvania. We will then learn whether I am correct in my surmise that it is a leaf-bearing species, closely allied to *J. setaceus*. The question may even arise, whether our plant is not the true *J. setaceus* of Rostkovius, as he credits it to Pennsylvania, and, so far as I know, the plant we take to be *setaceus* has not lately been found so far north. The figure of Rostkovius is too poor to decide the question, but his description is full enough to point to our *setaceus;* the "three-leaved calyx"—*i. e.*, the three bracts under the flower by which he distinguishes his species from *J. filiformis*—are found in most flowers of both *J. Smithii* and *J. setaceus*, and also in some other species, e. g., *J. tenuis*, but not in *J. filiformis;* the lowest of those three bracts generally bears an abortive bud in its axil, and has, therefore, another morphological value than the two upper ones.—The thin and wiry stems before me are two feet high, eight or nine inches of which belong to the spathe; the flowers are scarcely more than one line long, not much more than half as long as those of *J. setaceus;* the anthers had fallen off and only the six filaments remained; the thick but sharply angled and pointed capsule is light-brown and shining; its valves seem to tear away from the dissepiments when it opens. The seeds are few and of large size, 0.4 line long, and irregularly ribbed and reticulated.—The small flower, the form of the sepals, the exsert angular capsule, and the more elongated and differently marked seeds distinguish it abundantly from the next.

11. J. SETACEUS, Rostk. Mon. Junc. 13, t. 1, f. 2, is a regularly leaf-bearing species, though neither its author nor most of the later writers make mention of the leaves, while E. Meyer (Syn. Junc. 1822, p. 18) [445] already describes them, and Gray and Chapman are fully acquainted with them. Though its author credits the species to Pennsylvania, it is not now known to grow there; in all the herbaria examined by me I have seen no specimens found north of North Carolina, whence it extends as a common species to Florida and Louisiana. It is well characterized by its terete leaves; a very long spathe; a compact or sometimes spreading, few-flowered panicle; smooth and shining sepals; a globose scarcely angled but conspicuously rostrate capsule, the dissepiments of which separate from the valves; and by the subglobose, obtuse, coarsely lineolate, or almost transversely reticulate seeds, with short appendages and distinct rhaphe, and seldom over 0.3 line long.

12. J. ARCTICUS, Willd. The only American specimens I have seen were brought from Greenland by Dr. Kane; they differ in no respect from the European plant. The seeds are 0.4 line long, obovate, oblique, obtuse, with very short appendages and distinct raphe; 12–16 ribs are visible on one side, with very faint cross-lines.

Of the plant which is found on the Russian islands Kodiak and Sitcha, on the northwest coast of America, I have seen too few and too incomplete specimens to form a definite opinion. It seems to me to constitute a subspecies of *J. arcticus*, which might be designated as *Sitchensis*, and which can be distinguished by the much elongated spathe, the larger flowers, nearly equal sepals, turbinate pyriform capsules, with very few and apparently smaller seeds.

13. J. DRUMMONDII, E. Mey. in Ledeb. Flor. Ross. 4, 235: cæspitosus; caulibus (pedalibus sesquipedalibus) teretibus filiformibus; vaginis setaceo-aristatis; spatha paniculam simplicem (subtrifloram) plus minus superante; sepalis lanceolatis acutis vel exterioribus interiora vix superantibus acutatis stamina 6 plus quam duplo excedentibus; antheris linearibus filamento paulo longioribus; stigmatibus ovario gracili prismatico stylo perbrevi coronato brevioribus inclusis; capsula ovato-oblonga triangulari retusa trilocular sepala æquante seu eis breviore; seminibus ovatis striato-reticulatis longe caudatis.—*J. compressus*, γ. *subtriflorus*, E. Mey. Linn. 3, 368, and Rel. Hænk. 1, 141; *J. arcticus*, Hook. Fl. Bor. Am. 2, 189; Gray, Pl. Hall & Harb. in Proc. Ac. Phil. 1863, p. 77.

Var. β. *humilis:* caulibus digitalibus; spatha brevissima 1–2-flora; sepalis obtusiusculis.

On the alpine heights of the Rocky Mountains of Colorado, *Hall & Harb.*, 563; to California, *Hillebrand;* the

Cascade Mountains, *Lyall;* and to Unalaschka; the variety on Mount Shasta, Calif., at an altitude of 8,400 feet, *Brewer.* — The soft, compressible stems are 8–17 inches high, and always, as far as I have seen, leafless; [446] and when Meyer (Fl. Ross. l. c.) says that they occasionally bear leaves, he had probably one of the allied leaf-bearing species before him, which are at first glance so much like our plant that they have been almost constantly confounded with it. The spathe is ½–1½ inches long and usually exceeds the flowers; in the variety it measures only 2 or 3 lines and is shorter than the flowers, of which the primary one is sessile and the accessory one peduncled, just as we see it in *J. biglumis.* Flowers 3 lines or more long; sepals green on the back, brown on the sides, pale and membranaceous on the margins; outer ones with 5–7 nerves; stamens less than one-half, often only one-third as long as the sepals; capsule deep chestnut-brown and shining; seeds 0.3 line, or including the tails, about 1 line long; appendages as long as, or longer than, the body of the seed, which is delicately striate, with 10 or 12 ribs visible (on one side), and distinctly cross-lined; it is one of the very few species in which we find the appendages as long as or longer than the seed itself.

14. J. Hallii, n. sp.: cæspitosus; caulibus (spithameis pedalibus) teretibus filiformibus folia teretia setacea longe superantibus; spatha paniculam subsimplicem paucifloram coarctatam vix seu parum superante; sepalis lanceolatis acutis, exterioribus paulo longioribus stamina 6 bis superantibus; antheris linearibus filamento paulo brevioribus; stigmatibus subsessilibus ovarium ovatum æquantibus inclusis; capsula ovata angulata retusa triloculari vix exserta; seminibus oblongo-linearibus striato-reticulatis longe caudatis. — *J. arcticus,* var. *gracilis?* Gray in Pl. Hall & Harb. l. c. p. 77, ex parte.

Near Lake Ranch, Colorado, *Hall & Harbour,* Rocky Mountain Flora, No. 562; for the former of whom, Mr. E. Hall, of Athens, Menard county, Ill., who discovered this and many other plants in that region, it is named. It seems to be a rare plant, as neither Dr. Parry nor any one else, so far as I know, has obtained it. — Stems very slender, 6–12 inches high; leaves from 2–5 inches long, grooved just above the vaginal part, terete upwards; spathe as long as, or a little longer than, the compact inflorescence, which consists of 2–5 flowers about 2 lines long; capsule deep brown, as long as, or longer than, the acute but not subulate-pointed, chestnut-brown, white-margined sepals; seeds 0.5–0.6 line long, the body of the seed being about 0.3 line long, and the appendages half as long as the body, or often shorter; I notice on one side of the seed about 10 delicate ribs.

15. J. Parryi, n. sp.: cæspitosus; caulibus setaceis humilibus (digitalibus spithameis) folia sulcata sursum teretia superantibus; spatha paniculam simplicissimam (1–3-floram) superante; sepalis lanceolato- [447] subulatis, exterioribus longioribus aristatis stamina 6 ter superantibus; antheris linearibus filamento bis terve longioribus; stigmatibus ovarium lineari-prismaticum in stylum attenuatum vix æquantibus inclusis; capsula prismatica acutata exserta triloculari; seminibus oblongis tenuiter striato-costatis longe caudatis. — *J. arcticus,* var. *gracilis?* Gray in Pl. Parry, p. 34, and in Pl. Hall. & Harb. l. c., ex parte.

On the western and northwestern mountains; *Dr. C. C. Parry,* the indefatigable explorer of those mountain regions, who has been so often mentioned in the pages of these Transactions, and for whom I have named this interesting little plant, discovered it in Colorado in 1861 (coll. No. 360); *Messrs. Hall & Harbour* found it in the same region (No. 561), *Dr. Hillebrand* in the Sierra Nevada, and *Dr. Lyall* in the Cascade Mountains: it is generally, as it seems, associated with *J. Drummondii.* — Stems very thin and wiry, 4–8 inches high, leaves one-half to two-thirds as long, deeply grooved for over half their length, terete upwards; spathe usually overtopping the flowers, often 1 inch or more long; flowers mostly two, very rarely three in number, 2½–3½ lines long, larger than those of the last two species, and distinguished by their bristle-pointed exterior sepals, which are greenish, with brown sides and white margin, and strongly nerved. After maturity the placentæ of the slender and very acute brown capsule become detached from the valves and persist in the centre. The whole seed is about 1 line, and the body alone about 0.4 line long; longitudinal ribs 10–12 on one side, cross-lines very faint. A Californian specimen before me has somewhat shorter capsules and smaller and thicker seeds, but shows no other difference.

16. J. trifidus, Linn., apparently a rare plant in North America; thus far found only on the highest mountains in New York, New Hampshire, and Maine, and in Newfoundland and Greenland. — American specimens do not differ from those of Europe. The seeds are few and large, irregularly compressed, very faintly striate, with very short appendages; 0.7–0.8., or even as much as 1.1 lines long, and 0.3 line or more in diameter.

17. J. biglumis, Linn.: the only American localities known to me are those given by Hooker (Fl. Bor. Am. 2, 192) — "Arctic sea coast and islands, Rocky Mountains north of Smoking River, and Behring's Straits." A specimen from the Arctic sea coast, which I had the opportunity of examining, does not differ in any respect from the Norway and Lapland plant. The body of the seed is ovate-oblong, 0.34–0.42 line, and with the appendages 0.66–0.72 line, long; these are equal to, or shorter than, the diameter of the seed. In a Scotch specimen I [448] have seen a regularly tetramerous flower, with 8 sepals, 8 stamens, and a 4-valved capsule. The leaves, which botanists do not seem to agree upon, appear to me fistulous, on the lower half so deeply grooved as almost to present two cavities, and upwards nearly terete or slightly flattened. Its alliance with *J. Parryi* is indeed very close.

18. J. TRIGLUMIS, Linn., on the Arctic coast and in the Rocky Mountains; in Colorado, *Parry* 395, and *Hall & Harbour*, 557. — The seeds are of the same size as in the last species, but the appendages are much longer, though only in a specimen from Zermatt, Switzerland, I have seen them longer than the body of the seed. The roundish leaves are channelled below and flattened upwards, and really enclose two, or even three, tubular passages.

19. J. STYGIUS, Linn. From northwestern New York to Maine, New Brunswick, and Newfoundland. The seeds of this are the largest of any of our species; the body is 0.7–0.8, and the whole seed 1.5 lines long; the seed-coat, extremely loose and easily removed, is scarcely striated. Mention has already been made of the short and recurved stigmas which are peculiar to this species; the filaments are 8 or 10 times as long as the oval anther, and much longer than the pistil; the flowers, in the American specimens examined by me, are 3 lines long, while in one from Norway I find them only 2 lines long. A careful examination of the leaves proves them to be somewhat laterally compressed, with a very shallow groove on their lower part (generally a little on one side), and the interior cavity filled with very loose tissue which divides it into several (3–5) tubes.

20. J. CASTANEUS, Smith: the lower part of the terete fistulous leaves is so deeply channelled that their base appears equitant, and that in the herbarium the pressed leaves look like the averse and ensiform leaves of *J. xiphioides;* but their back is rounded and not in the least carinate, and the upper part of the leaf is only very superficially grooved. The flowers are usually over 3 lines long, and the stamens, as well as the elongated ovary with the short style, attain the length of the sepals; linear, pointed anthers half as long as the filaments; stigmas exsert; oblong seeds, 0.4–0.5 line, or with the appendages, which considerably exceed the seed in length, 1.6 lines or more, long, the longest of any of our species. — From the Rocky Mountains of Colorado to the northwest coast, and eastward to the Hudson Bay regions and to Newfoundland.

21. J. VASEYI, n. sp.: cæspitosus; caulibus (1–2-pedalibus) tenuibus rigidis striatis basi fusco-vaginatis; foliis elongatis setaceis teretiusculis striatis versus basin sulcatis farctis; spatha paniculam parvam contractam [449] æquante seu raro superante; sepalis æquilongis lanceolatis, exterioribus apice subulatis, interioribus latioribus mucronatis stamina 6 plus quam duplo superantibus; antheris filamenta æquantibus; stigmatibus ovarium ovatum cum stylo brevi vix æquantibus inclusis; capsula straminea ovata sursum tricocca retusa triloculari sepala æquante seu paulo superante; appendicibus semini ipso lineari costato-lineolato paulo brevioribus.

On the banks of Fox river, near Ringwood, in Northern Illinois, "a few years ago, in an open wood, now plowed over," *Dr. George Vasey*, who paid a good deal of attention to this genus and to the botany of his neighborhood generally, and for whom this species is named; on the Saskatchawan, *Bourgeau;* in the Rocky Mountains, *Drummond;* and, mixed with *J. tenuis*, in Colorado, *E. Hall.* — The wiry stems, 1 or 1¼ to 2 or 2¼ feet high, are covered at base with brown sheaths, the innermost of which bear very slender terete leaves, shorter than the stem, and channelled only near the base, so that our plant is thus most closely allied to those of the first section; its inflorescence, however, is decidedly terminal, and connects it with *J. tenuis* and its relatives. The compact panicle is ½–1 inch long, green, or, when fully ripe, of a light brownish straw color; flowers 2 lines long; seeds very slender, body about 0.3, and with the appendages, 0.5–0.7 line long. This species is the western representative of *J. Greenii*, from which it is distinguished by the longer stems, the terete, scarcely channelled leaves, the lighter colored flowers, the shorter capsule, and by the slender seeds with longer appendages.

22. J. GREENII, Oakes & Tuckerm. Sillim. Journ. 45 (1843), p. 37; Steud. Glum. 2, 305; Gray Man. ed. 2, 483: cæspitosus; caulibus (pedalibus sesquipedalibus) rigidis strictis striatis basi parce stramineo-vaginatis; foliis caule brevioribus teretiusculis totis profunde sulcatis; spatha paniculam contractam ad ramos ultimos secundifloram plerumque longe superante; sepalis (stramineo-fuscis) lanceolatis subulatis subæqualibus seu interioribus paulo brevioribus cuspidatis stamina 6 duplo superantibus; antheris filamenta æquantibus; capsula ovato-oblonga retusa sepala excedente (pallide fusca) triloculari; seminibus obovatis costato-lineolatis breviter caudatis.

On the coast of Massachusetts and Rhode Island (to Long Island?) and on the Saco River at the foot of the White Mountains. — Few and pale sheaths at the base of the stem; leaves deeply channelled all their length; panicle contracted, with erect one-sided branches 1–1½ inches long; flowers 1.7–1.8 lines in length; seeds 0.25–0.30 line, and with the appendages, 0.37–0.40 line long, appendages about half as long as the diameter of the seed.

23. J. TENUIS, Willd., is one of the most common and best known, but also one of the most variable [450] species, and can always be readily distinguished from all the allied ones by its flat leaves, which only in the narrow-leaved forms are on the margin slightly involute; by the lanceolate, subulate sepals of equal length, which somewhat exceed the ovate, retuse capsule, and principally by the small, mostly oblique, delicately lineolate seeds, with distinct but short whitish appendages; they are very similar to those of *J. effusus*, and are mostly 0.25–0.28, rarely only 0.20 line long.

Notwithstanding the great variability in the size of the plant (from a few inches to two feet), in the size and development of the one, two, or even three spathes, and in the size and fulness of the inflorescence (1–5 or 6 inches in length), I can distinguish only the following well-marked varieties: —

Var. β *secundus*, ramis paniculæ spatham excedentibus erectis incurvis ; floribus minoribus secundis. — *J. secundus*, Poir.

Var. γ. *congestus*, ramis paniculæ spatha brevioribus abbreviatis; floribus fere in capitulum congestis; sepalis fusco-striatis ; capsula e stramineo fusca.

The legitimate *J. tenuis* is found over the whole country, from the Atlantic to the Pacific, and south into the tropical parts of America, in the West Indies, and in western Europe. — The interesting and quite distinct-looking variety with unilateral flowers has usually 4 or 5, but sometimes even 6 or 7, flowers on a single[4] branch, which is curved inward and not backward, as is the case in *Borragineæ*, the one-sided inflorescence of which bears a great analogy to that of our plant. Most of the specimens of this variety which fell under my observation were obtained in Pennsylvania, and a few in New England ; forms approaching it are found in other regions also. — The variety γ., which occurs in California (San Francisco, *Bolander ;* Monterey, *Brewer*) and in Colorado, *Hall*, is very striking ; its apparent heads, 4–9 lines in diameter and nearly as high, bear flowers a little larger than ordinary, with darker colored sepals. The seeds of both varieties are undistinguishable from those of the common plant.

24. J. DICHOTOMUS, Elliott, Sketch, 1, 406 ; Chap. Flor. 493; though closely allied to the preceding, is a well-marked species, and would not have so often been confounded with it if the characters, as given by Elliott, had not been overlooked. The terete leaves, which are marked by a shallow groove on their upper side, distinguish it at once, even when the subglobose, mucronate, but never retuse, capsule is not yet formed. The seeds are very [451] similar to the smaller ones of *J. tenuis* (0.22–0.23 line long), and have the same oblique white appendages, but they are coarsely lineolate, the meshes being about twice as wide as in the other species ; the bulbous base of the stem, indicated by Chapman, is perhaps not always so well marked. Mr. Bebb remarks that about Washington, where it is abundant, the contrast in the color of the mature plants of this and the last species is quite striking; the latter becomes pale throughout, while *J. dichotomus* remains dark green, and the ripe pods assume a mahogany color. — The northern limit of this species seems to be on the Chesapeake Bay, whence it extends to Florida.

25. J. GERARDI, Lois. Notic. (1810) p. 60, ex Kunth, En. 3, 352 ; Koch, Syn. Germ. 731, is well distinguished from *J. bulbosus*, Linn., which has never, I believe, been found in America, by the subterete stem, the much larger flowers, which are as long as the capsule; by the large linear anthers and very short filaments, the long style, which is equal to the ovary, and by the larger seeds. These are 0.31–0 33 line long, while those of *J. bulbosus* are only 0.23 line long; both are delicately lineolate. — It is a salt water plant, and is found in brackish marshes from the British possessions to North Carolina, *Curtis*, and Florida, *Ware* (*J. Floridanus*, Raf. in Hb. Durand) ; inland it has been found by *Judge Clinton* about Salina, western New York ; and near Chicago by *Dr. Vasey*. On the coast of New England it is well known under the name of "black grass," and is cut in large quantities and makes pretty good hay (*Oakes*).

26. J. BUFONIUS, Linn.: this well-known weed, found all over the globe, and, perhaps with the exception of *J. saginoides*, the only annual *Juncus* of our flora, is most variable in its size, the size and disposition of the flowers, the proportion of inner and outer sepals, and the size of the seeds. The seeds are ovate, very obtuse, and commonly very slightly apiculate, and delicately lineolate ; 0.15–0.20 line is their usual length ; I have rarely seen them 0.22 line long, and in a Galveston specimen have found them only 0.13 line long.

Only one marked variety has been distinguished under the name of *fasciculatus*, Koch, or *fasciculiflorus*, Boiss., apparently a southern form, common in our southeastern States and in the south of Europe ; it is also found in the interesting colony of southern plants near the Philadelphia navy-yard; the last three or four internodes of the branches of the inflorescence are so much shortened that the flowers become crowded into false heads, which gives the plant a very peculiar aspect.

27. J. REPENS, Michx. Fl. 1, 191. *Cephaloxys flabellata*, Desv. ; Chapm. Flor. 496. A well-marked south- [452] eastern species, found from Maryland, *Canby*, to Florida, Alabama, and Louisiana ; it is a true *Juncus*, as I have shown above, and evidently, notwithstanding its great difference, nearly allied with the last species. Seeds obovate, somewhat pointed, about 0.2 line long, and delicately lineolate.

28. J. FALCATUS, E. Mey. Synops. Luzul. p. 34 ; in Rel. Hænk. 1, 144, et in Led. Fl. Ross. 4, 228, excl. syn. ; Kunth, En. 3, 360 : rhizomate ascendente stolonifero ; caulibus (digitalibus pedalibus) erectis lævibus compressis unifoliatis seu nudis ; foliis gramineis planis adversis plerumque oblique ad latus deflexis inde falcatis ; capitulis subsingulis spatha sæpius brevioribus ; floribus (majoribus castaneis) extus scabris pedicellatis; sepalis ovatis, exterioribus acuminatis interiora obtusa subinde mucronulata æquantibus seu eis brevioribus; staminibus 6 dimida sepala superantibus ovarium obtusum cum stylo ei æquilongo æquantibus, antheris late linearibus filamento multo longioribus ; stigmatibus elongatis exsertis ; capsula obovata obtusa mucronata triloculari ; seminibus (ex Hooker) testa producta lineari-oblongis. — *J. Menziesii*, R. Brown in Hook. Fl. Bor. Am. 2, 192.

[4] These branches are only apparently single axes, for in reality they are formed of many short, successive branches.

From the Russian island of Unalaschka, *Chamisso*, to California, *Hœnke*, *Eschscholtz*, *Douglas*, *Coulter* 808, *Bolander*, and on the Cascade Mountains, 49 deg., *Lyall*. — A very striking and much controverted plant, as distinct from *J. castaneus* as it is from *J. ensifolius* and *J. Mertensianus*, with all of which different authors have thrown it together; the perfectly flat and adverse (*i. e.* the flat surface facing the stem) leaves, the very broad and scabrous sepals, and the long anthers on short filaments, distinguish it fully from all these. — Eschscholtz's specimens in Hb. Gray are only 1½–3 inches, while those of Lyall are 15 inches high; 6 or 8 inches is their usual size. The leaves are of different lengths, shorter than or sometimes exceeding the stem, and are usually laterally bent so that even the stipular appendages of the sheath are unequal. Heads mostly single, sometimes two or three, ¼ inch in diameter, composed of from 8 to 18 large (3 lines long) flowers; sepals remarkably broad and rough on the outside, chestnut-brown or (in Coulter's and Lyall's specimens) green with two lateral brown stripes; this roughness seems to be constant in this species, and in no other have I seen it. Meyer (Rel. Hænk. l. c.) says of the fruit in Chamisso's specimen: *trigono-pyriformis, perianthio paulo longior trilocularis; seminum testa laxior albicans sed non scobiformis.* None of the specimens before me have ripe fruit, only one, from the Cascade Mountains, shows a half-developed capsule with young seeds, and these are undoubtedly tail-pointed and already 0.6 line long; Dr. [453] Hooker (Bot. Antarct. Voy. Fl. Tasm. 2, 64) speaks of the seed of this species as "linear-oblong, striate, with the testa produced beyond either end," and as the Tasmanian plant[5] has very different seeds, his remark must refer to the Californian species.

Hooker & Arnott, Bot. Beechey, p. 402, distinguish from the original *J. Menziesii*, with obtuse sepals, the variety *Californicus*, with acuminate ones. I have found, in all the specimens examined by me, the outer sepals acuminate and the inner ones obtuse, with or without a mucro; but in some, as stated before, the outer ones are much shorter than, in others as long as, the inner ones.

29. J. LONGISTYLIS, Torrey in Bot. Mex. Bound. p. 223 : caulibus (pedalibus bipedalibus) cæspitosis stoloniferis teretiusculis sursum sæpius (sub lente) scabriusculis foliatis; foliis planis gramineis; capitulis paucis in paniculam contractam aggregatis seu raro singulis; floribus (majoribus viridulis fusco-striatis) lævibus pedicellatis; sepalis æqualibus ovato-lanceolatis acutatis seu cuspidatis stamina 6 duplo superantibus; antheris filamento subduplo longioribus; ovario stamina et stylum æquante, stigmatibus exsertis; capsula ovata obtusa mucronata seu rostrata castanea nitida triloculari calycem æquante seu paulo superante; seminibus oblanceolatis seu obovatis apiculatis costato-reticulatis. — *J. Menziesii*, Gray in Pl. Parry, p. 34, and Pl. Hall & Harb. p. 77, "the var. *Californicus*, Hook & Arn., probably an unpublished species."

Rocky Mountains from New Mexico, *Wright* 1924, *Fendler* 857, to Fort Whipple, Arizona, *Coues & Palmer*[6] 48, and northward to Colorado, *Parry* 631, *Hall & Harb.* 566, to the Saskatchawan, *Bourgeau*, and towards Oregon, *Lyall*. — Stems cespitose, or, probably in richer soil, stoloniferous, 1–2 feet high; panicle usually 1½–2½ or 3 inches long, consisting of 5–9 heads; heads 3–8 or 12-flowered, sometimes fewer or single, and then 12–15-flowered; flowers 2½–3 lines long; stamens as long as the ovary, so that the style, which is of the same length, protrudes beyond [454] them; seeds 0.25–0.27 line long, oblanceolate and acute, or, in the Fort Whipple specimens, obovate and upwards obtuse; these specimens are also distinguished by the absence of all traces of stolons, and by the slightly roughened surface of the upper part of the stem. — From the closely allied *J. falcatus* our plant is distinguished by the greater size, the paniculate heads, the shape, proportion, and surface of the sepals, and the shape of the seeds.

30. J. LEPTOCAULIS, Torrey & Gray in Herb. Durand : caulibus cæspitosis erectis (spithameis pedalibus) gracilibus compressiusculis fistulosis paucifoliis; foliis planis caule brevioribus; capitulis singulis seu paucis (1–3) spatham fere æquantibus 3–6-floris; bracteis ovatis aristatis flore subpedicellato plerumque brevioribus; sepalis ovato-lanceolatis acuminato-aristatis æqualibus seu exterioribus paulo brevioribus stamina 3–6 et capsulam obovatam tricoccam retusam mucronatam trilocularem quarta parte superantibus; antheris oblongo-linearibus filamento bis terve brevioribus; stigmatibus ovarium obovatum cum stylo perbrevi æquantibus inclusis; seminibus obovatis apiculatis costato-lineolatis. — *J. filipendulus*, Buckley in Proc. Acad. Phil. 1862, p. 8.

Arkansas, *Herb. Durand*, Western Texas, *Lindheimer*, *Wright*, *Buckley*. — Whole plant light green; gracile stems 6 or 8 to 12 and 14 inches high, growing in dense tufts from very small but apparently perennial rhizomas; heads single or rarely two or three, the secondary ones pedunculate and overtopping the primary one, in fruit 4–5 lines in

[5] The Tasmanian *J. falcatus*, Hook. f. l. c., of which I find a good specimen with ripe fruit, collected by Gunn, in Hb. Gray, is certainly very similar, but seems to be distinguished by smaller but also scabrous flowers, ovate retuse capsules of the length of the equal acutish sepals, and obovate, obtuse, abruptly apiculate reticulate seeds, the areolæ of which are *perpendicularly* lineolate; it might be distinguished by the name of *J. Tasmanicus*.

[6] While this sheet was in the hands of the printer I received a most interesting collection of Arizona Plants, made last year by Drs. Elliott Coues and Edward Palmer, in which I found good specimens of this species, and also some of *J. compressus*, unfortunately again without fruit; the leaves of this last, however, are finely developed, thus adding another proof for the opinion that it is really a regularly leaf-bearing species. (Compare p. 440.)

diameter, consisting of 3–6 or 7 light green flowers: these not quite $2\frac{1}{2}$ lines long, remarkable for the elongated sharp points of the inner as well as the outer sepals, and for the irregular number of stamens; stamens sometimes 3, often 4 or 5, rarely 6, some of the inner ones commonly depauperate, with very slender filaments and extremely small anthers; seeds very similar to those of the next species, 0.22 line long, with about 6 strong and dark ribs visible on one side.

I had to change the only published name of this species, *J. filipendulus*, because it is absolutely wrong, the fibrous rootlets bearing no tubers at all; intending to substitute the name of the author and call it *J. Buckleyi*, I discovered, from a label in Mr. Durand's herbarium, that Torrey and Gray had already named the species; I therefore adopt their very appropriate designation.

31. J. MARGINATUS, Rostk. Mon. Junc. 38, t. 2, f. 2: a well-known species which grows all over the eastern and interior States, and down to Texas as far as woodlands extend, but has not been found in the western plains or mountains. It is distinguished from all our other species by the purple, or when dry red-brown color (already [455] noticed by La Harpe) of its three anthers, which usually exceed the outer sepals in length; it is further characterized by the acute outer sepals being much shorter than the obtuse or sometimes mucronate inner ones; by the ovate, obtuse ovary, with the almost sessile enclosed stigmas of the same length; and the subglobose, obtuse, mucronulate capsule. The seeds are quite variable in size and form, but always strongly pointed or almost caudate and conspicuously ribbed, with few (4 or 5, or at most 6) ribs visible, lineolate or rarely reticulate; they are commonly slender, obliquely lanceolate or fusiform, but in Lindheimer's Fl. Tex. exsicc. 193, which has been named *J. heteranthos*, they are quite short, ovate-obtuse and abruptly apiculate. The length of the seeds varies from 0.22 to 0.33 line, and their thickness from $\frac{1}{4}$ to $\frac{1}{2}$ of their length. — *J. aristulatus*, Michx. 1, 191, and *J. aristatus*, Pers. Syn. 1, 385, are exactly the same; *J. biflorus*, Ell. Sketch, 1, 407,[7] and *J. heteranthos*, Nutt. Pl. Arkans. in Trans. Am. Phil. Soc. V. 153, are forms of the same with fewer flowers in the head. *J. cylindricus*, Curtis, Sillim. Journ. 44, 83; Steud. Glum. 2, 304, is a form with heads elongated into spikes 6 lines long and 3 lines in diameter, sterile below, only the uppermost flowers bearing fruit; outer sepals almost as long as inner ones. We may distinguish the following forms: —

Var. *α. vulgaris*, $1\frac{1}{2}$–3 feet high, with 5–8-flowered heads in a compound or decompound panicle; the common form.

Var. *β. biflorus*, as tall as the former, with 2–3-flowered heads in a decompound and often very large panicle; a southern form, from Delaware, *A. Commons*, to Texas.

Var. *γ. paucicapitatus*, 1–$1\frac{1}{2}$ feet high, with few (2–6 or 8) larger 8–12-flowered heads; Long Branch, New Jersey, *C. W. Short*, and elsewhere.

32. J. PELOCARPUS, E. Mey. Synops. Luzul. p. 30; La Harpe Monog. 124; Kunth, En. 3, 333, non Auct. Amer.: rhizomate horizontali tenui pallido; caulibus (spithameis pedalibus et ultra) gracilibus teretiusculis erectis paucifoliis; foliis teretiusculis indistincte nodulosis; paniculæ decompositæ laxæ ramis plerumque elongatis secundifloris demum recurvis; floribus (parvis) singulis binisve sæpe in gemmam vel ramulum foliosum abortientibus; sepalis oblongis obtusis, exterioribus plerumque brevioribus rarius mucronatis stamina 6 et ovarium acuminatum in stylum breviorem abiens vix superantibus; antheris late linearibus filamento multo (duplo quadruplo) longiori- [456] bus; stigmatibus exsertis; capsula triquetra acuminato-rostrata 1-loculari exserta; seminibus obovatis breviter apiculatis reticulatis, areis lineolatis. — *J. Muhlenbergii*, Spreng. Syst. 2, 106 (1825). *J. viviparus*, Conrad in Journ. Ac. Phil. 6, old ser. part 1, p. 105. *J. Conradi*, Tuckerm. in Torr. Fl. N. Y. 2, 328 (1843); Gray Man. ed. 2, 482; Chapm. Fl. 495. *J. dichotomus* in herb. plur.

Var. *β. crassicaudex*, e rhizomate crasso caulibus foliisque robustioribus. — *J. abortivus*, Chapm. Fl. l. c.

Var. *γ*? *subtilis*, caule reptante vel fluitante radicante folioso: foliis brevibus setaceis ex axillis proliferis; floribus subbinis 3-andris. — *J. fluitans*, Michx. Fl. 1, 191. *J. subtilis*, E. Mey. Syn. Luz, 31; La Harpe Mon. 135.

From Newfoundland (ex La Harpe) and Canada, *Macrae*, westward to Lake Superior, *Robbins*, and southward, chiefly along the coast, to South Carolina, *Curtis*; var. *β.* in Florida, *Chapman*; var. *γ.* in Canada, *Herb. Michaux.* — A very peculiar and morphologically very important plant, the synonymy of which has been quite obscure. Meyer's original diagnosis is too short, so that it permits strong doubts about the identity of the plant he had in view, and his unfortunate comparison of his species with *J. lampocarpus* and *J. paradoxus*, "*cujus habitum refert*," necessarily throws botanists on the wrong track. But La Harpe,[8] who wrote only two years after Meyer's publication, and who seems to have been well acquainted with Meyer and with his species, gives a full description, which can leave no doubt, even if Meyer's herbarium did not settle the difficulty. Though originally the species was described from specimens in C.

[7] The inner sepals, however, are not the shortest, as the usually so careful and reliable Elliott, probably by a lapse of the pen, says, but, as in all the forms of this species, the longest.

[8] Jean de La Harpe's "Monographie des vraies Joncées" seems to be little accessible to botanists; it was published, 1825, in the third volume of Mémoires de la Société d'Histoire Naturelle de Paris, pp. 89–181, and is a work of careful research, in which I believe I can trace the conscientious investigation and the critical spirit of my old and highly esteemed, now departed, friend, Jacques Gay, of Paris. La Harpe was the first to give full and careful descriptions of

Sprengel's collection, which seem also to have been the originals of his *J. Muhlenbergii* (most probably received from Muhlenberg himself), several specimens, obtained later from different sources (*e. g.* E. Tuckerman and A. Gray) are preserved in Meyer's herbarium with the name of "*J. pelocarpus*" in his own handwriting; and others so named by him are found in the royal herbarium at Berlin. Now, this plant is so peculiar that no one who has ever examined it can confound it with any other; is it, then, at all probable that Meyer himself should have done so in his [457] own herbarium? His original specimens may not have exhibited the foliaceous excrescences, so that he could not mention them in his description of this species, while he did allude to similar ones in his account of his *J. paradoxus;* his diagnosis is so short that he does not even mention the unusually small number of flowers.

The rhizoma is whitish and slender, often almost filiform, and sends out few and distant, or sometimes more crowded, slender and almost terete, not flattened, stems, 4 or 6 to 18 or 20 inches high; leaves slender, almost setaceous, scarcely compressed, and incompletely knotted. The panicle shows very different forms in different specimens; sometimes, probably in the earlier part of the season, it is only 2 or 3 inches long, and moderately spreading, with flowers more crowded; but usually, at least in the numerous herbarium specimens examined by me, and perhaps later in the season, it attains a length of 4 or 6 inches, with about the same diameter, the few slender spreading or recurved branches bearing the distant flowers on one side. The flowers are green, with a reddish tinge, especially on the inner sepals, usually 1.0–1.3 lines long, and generally single; sepals obtuse, sometimes mucronate, or rarely the outer ones acutish; these are generally shorter than the inner ones; but in a Lake Superior specimen the flowers are only 0.8 line long, and all the sepals equal, broadly oval and obtuse. Stamens about the length of the outer sepals; anthers always longer than filaments, sometimes scarcely twice as long, in others fully four times their length. Style shorter than the acuminate ovary. The capsule ought not to have been described as Meyer and (copying him) La Harpe did, as *triquetro-ovata mucronata;* it is rather, as Gray has it, taper beaked, and is completely one-celled, the lateral placentæ occupying only the lowest third or fourth part of the commissure of the valves. Seeds 0.25 line long, delicately but distinctly reticulate, areæ transversely lineolate.

I cannot distinguish Dr. Chapman's *J. abortivus* from the northern plant except by the not essential characters given above; the flowers are absolutely identical, and fruit I have not seen.

With some hesitation I add *J. subtilis* as a procumbent or floating variety with short internodes, and short leaves which bear leaf-buds in their axils. In American collections this form does not seem to exist, but La Harpe, who saw it in Michaux's herbarium in Paris, gives a full description of it, from which I have extracted above; the flowers are described exactly like those of *J. pelocarpus*, and there is, notwithstanding the different habit, nothing in it that would specifically distinguish it, except the smaller number of stamens, and the single, two-flowered heads; [458] fruit and seed are unknown. I take it for a depauperate water form of our species, while Hooker, Fl. Bor. Am. 2, 191, unites it with *J. uliginosus*, which with him is what I have taken for *J. alpinus;* but that is also a 6-androus species. The botanists of Canada and of our northern border ought to find it again and clear up these doubts.

I have already (p. 426) spoken of the great morphological importance of this plant, which connects the single-flowered with the head-flowered species, and proves, as certainly might have been expected beforehand, that no absolute difference exists between them: that the flowers in all of them are really lateral; that in the former only one flower is formed, while in the others a series of them, from two to an indefinite number, are developed in centripetal order. In our species a second flower is more commonly not present, and its place is occupied by a bud, which often, and especially later in the season, grows to a leafy excrescence (whence the name *viviparus*); sometimes even the first flower is replaced by a leaf-bud, and in rare instances a leaf-bud makes its appearance between two flowers as a third axillary organ. I have never seen more than two flowers, nor more than one leaf-bud in a head. Botanists who have the opportunity ought to investigate the variations in the inflorescence of this plant according to locality, season, or other circumstances.

33. J. ARTICULATUS, Linn. That form of the Linnean species which was distinguished by Ehrhart as *J. lampocarpus*, and which is common in northern Europe, has a very limited range in North America. All the specimens I have seen came from the New England States (Boston, *Pickering;* Amherst, *Tuckerman;* and Providence and Nantucket, *Olney*) and from western New York (Penn Yan, *Sartwell*); to these La Harpe adds Newfoundland.— Stems densely cespitose from a creeping rootstock, with us usually erect and about one foot high; panicle short, dense-flowered, spreading, brown; sepals mostly equal, lanceolate, acute and mucronate, or inner ones slightly longer and sometimes obtusish; stamens about two-thirds the length of the sepals, and anthers as long as filaments; ovary acuminate, terminating in a style about half its length; capsule longer than the sepals, acute, or even rostrate, at least in all the American specimens seen by me, and imperfectly three-celled, the placentæ not meeting in the centre. Seeds obovate,

these plants, and of all their organs, and only after the date of his publication do we find in Meyer's papers similar extended accounts in place of the former short diagnoses, *e. g.* in the *Junci* of the *Reliquiæ Hœnkeanæ*, published 1827. Not having been able to compare Michaux's original plants, I have with confidence relied on the critical references of La Harpe, especially in regard to species about which doubts had existed, such as *J. fluitans*, *acuminatus*, and *polycephalus*.

obtuse at the upper, acute at the lower end, and at both strongly apiculate ; 0.3 line or a little less long, and about half as much in diameter ; reticulate, with areæ finely cross-lineolate ; 7 or 8 ribs visible.

34. J. ALPINUS, Villars, Delph. 2, 233 ex Koch, Syn. Germ. 730. *J. fusco-ater*, Schreb. ex Kunth, En. 3, 326. *J. affinis*, R. Brown. *J. Richardsonius*, Rœm. & Schult. *J. pelocarpus*, Gray, Man. ed. 1, 507, in part, non [459] Mey. *J. articulatus*, var. *pelocarpus*, Gray, Man. ed. 2, 482, in part. *J. elongatus*, Vasey, in herb.— This form ought, perhaps, not to be separated from the last species ; but with us it is easily distinguished, and occupies a distinct geographical range. I, therefore, keep them apart for the present, and leave the final decision to the botanists of Europe, where both forms are much more abundant. — With us this species is confined to the northern and western parts of the continent, where it is usually found on the sandy or gravelly banks of lakes or streams ; from Lake Champlain, *Robbins*, *Macrae*, and Seneca and Ontario lakes, *Sartwell*, where it meets the eastern *J. articulatus*, northward to the Hudson Bay regions, *Drummond* and others, and the Arctic shores, and westward along the Great Lakes to Detroit, *Bigelow*, *Herb. norm.* 51, Northern Illinois, *Casey*, and the upper Platte, *Hayden*, Colorado, *Hall & Harb.* 558, and beyond the Rocky Mountains toward Fort Colville, *Lyall*.

Stems erect from a creeping rootstock, 10–18 inches high ; branches of the meagre panicle, at least in the larger specimens, strictly erect and much elongated, greenish and light brown; sepals oblong, obtuse, outer ones mucronate or cuspidate, equal to, or exceeding, the rounded inner ones ; stamens same as in last; ovary ovate, with a very short style ; capsule as long as or a little longer than the sepals, obtuse, mucronate, incompletely three-celled ; seeds very similar to last, but usually more slender, oblanceolate and acute at both ends, rarely obtuse at the upper one, 0.30–0.35 line long. — The alpine form of this plant, the original type of Villars, is found in our Arctic regions, and is only a few inches high, bearing very few almost black heads, and has the slenderest and longest seeds. The ordinary American plant is distinguished from the usual European form by its lower stems, still stricter panicle, and paler flowers and fruit. Fries has sent absolutely the same from Sweden, formerly as *J. sylvaticus*, and as *J. acutiflorus*, and later as *J. alpinus*, var. *insignis*, which name may be retained for it.

35. J. DUBIUS, n. sp.: rhizomate crasso horizontali ; caulibus (1½–3-pedalibus) erectis cum foliis tereti-compressis ; panicula supradecomposita patula; capitulis pauci-(6–10)floris stramineis ; floribus subsessilibus; sepalis lanceolato-subulatis acutissimis æqualibus stamina 6 fere duplo superantibus ; antheris linearibus filamento sublongioribus ; capsula lineari-prismatica acutata uniloculari exserta ; seminibus obovatis utrumque apiculatis areis lineolatis reticulatis.

Forming large tufts in wet granitic sand in Clark's meadow, near the Big Tree Grove, Mariposa, California, at an altitude of 6,500 feet, *H. Bolander*, flower and fruit in July ; Cal. State Surv., 6032, Hb. norm. 52. With a [460] good deal of hesitation, expressed in the specific name given to this plant, I venture to separate it from the closely allied *J. oxymeris* of the same region. Its rounded and only slightly compressed leaves certainly seem to be very distinct from the flattened equitant leaves of the latter species ; but otherwise the whole appearance, the rhizoma, the panicle, the flower, the stamens even, and the fruit, show scarcely any difference ; only the seed proves distinct, and as, I believe, we can safely rely on characters derived from the sculpture of this organ, we must consider both as really distinct species. The seeds of *J. oxymeris* show on one side 7–9 ribs and a distinct reticulation, the areæ being smooth, and only the ribs slightly crenulate ; *J. dubius* has seeds of the same size (0.22–0.25 line long), but with fewer (5–7) ribs, and larger, strongly lineolate areæ. The panicle of this plant is 3–5 inches long, the flowers slender, and with the capsule nearly 2 lines long.

36. J. MILITARIS, Bigelow, Flor. Bost. ed. 2 (1824), p. 139 ; Gray, Man. ed. 2. p. 482, was "discovered by *B. D. Greene* at Tewksbury," and has since been traced from Maine, *Blake*, to Massachusetts, and southward to the Pocono Mountains in Pennsylvania, *T. Green*, New Jersey, *Asa Gray*, *C. F. Parker*, Maryland, *A. Commons*, and, if there is no error in the label, as far as Alabama, *Drummond*. — The stout stems, 2 to 4 feet high, spring from a creeping rootstock, and bear on their lower half a single leaf, ½–3½ feet long, which usually overtops the inflorescence, and is mostly followed by a second very short one, rarely developed beyond the vaginal part. The decompound, rather crowded and often somewhat contracted light brown panicle is 2 to 5, usually about 3, inches long; the heads are 5–12-flowered, only in a Maryland specimen I find them 15–25-flowered. Flowers (in the North in August) 1½ lines long ; sepals lanceolate, outer ones subulate-pointed or even aristate, mostly very little shorter than the acute inner ones ; stamens 6, two-thirds the length of the sepals ; linear anthers a little longer than the filaments; stigmas exsert, as long as the ovate acuminate ovary and the distinct style together; capsule sharply triangular, ovate, acuminate, rostrate, equalling or slightly exceeding the sepals, one-celled ; seeds obovate, obtuse, unusually thick, and abruptly apiculate, 0.25–0.30 line long, and three-fifths of their length in diameter, neatly reticulate, the areæ marked with few longitudinal lines ; 8 to 10 ribs visible.

Dr. Robbins has discovered a very curious peculiarity of this plant, which abounds in the Blackstone River, near Uxbridge, Massachusetts, and its tributaries, and in the flumes of the manufactories, but only in rapid parts of these streams, and is there not found in sluggish streams or in stagnant water. It seems that about the period [461]

of maturing the seeds, at the end of August, the long horizontal rhizoma, which at its end is to bear the flowering stem of next season, begins to shoot forth, and from the axils of its scales produces a number of extremely short or rudimentary branchlets which are again branching and form short knobs on the rootstock. These branchlets bear a number of capillary leaves of the thickness of horsehair, but knotted like the ordinary leaves of this species, at this time, end of August, few in number, and only a few inches long. Towards the close of the season they increase in number and length, and seem to live through the winter wherever they are immersed deep enough to escape the frost. They attain their full development about May and June, when they are 2 or 3 feet long, and carpet the bottom of those streams, at the depth of 2 to 4 feet below the surface, with their dark green undulating masses, most beautiful to look at, but quite obnoxious to the proprietors of the mill-streams, the sluices of which they are apt to obstruct. These leaves decay about the period the plant begins to bloom. The beautiful specimens collected by Dr. Robbins for the Herbarium Normale (No. 53) exhibit them to perfection. The twist and bend of the stem of many of Dr Robbins' flowering specimens is caused by the strong current in which they grew. The only thing approaching such submerged leaves, Mr. Parker has found in the Delaware above Philadelphia, where this plant grows "in shallow water, extending to the border of deep running water, the finest specimens growing at a depth of 3 or 4 feet." How does this species grow in stagnant ponds or swamps? It would be very desirable that collectors of *Junci* should pay more attention to the circumstances under which these plants occur, the process of their vegetation, the time of flowering and of maturity, and, of course, to the base of the stem and to the rootstock, which is too often a vain desideratum in herbarium specimens.

37. J. SUPINIFORMIS, n. sp.: foliis vernalibus e basi latiore subulatis capillaceis longissimis teretibus pallide virentibus natantibus evanescentibus; caule florifero erecto humili (digitali vel ultra) folia erecta teretia longiora gerente; panicula simplici; capitulis sub-5-floris; sepalis ovato-lanceolatis cuspidatis nervosis æqualibus seu externis paulo brevioribus inter se inæqualibus stamina 3 stigmataque paulo excedentibus; antheris oblongis filamento multo brevioribus; stylo perbrevi; capsula prismatica obtusa mucronata uniloculari calycem fere excedente; seminibus obovatis utrumque apiculatis.

Common in and around ponds, near Mendocino City, California; May and June, *H. Bolander*, Cal. State Surv. 4767. — Mr. Bolander informs me that in spring these ponds are completely covered with the pale green [462] capillary leaves of this species, 1 or 2 feet long. As the water recedes with the advancing dry season, the erect flowering stems begin to form, and a little later the vestiges of the decayed vernal leaves cover the remaining mud with grayish spiderweb-like filaments. The flowers are nearly 2 lines long, the (immature) capsule is prismatic with concave sides; the seeds, too imperfect to make out their sculpture, were 0.27–0.30 line long, large for the size of the plant.

This species is closely allied to *J. supinus* of Europe, whence the name, and appears to stand next to its var. *fluitans;* but that species has smaller flowers, with obtuse sepals, an obtuse capsule, and smaller seeds. These characters, however, do not seem to be quite constant, so that further examination of more complete specimens will be necessary.

38. J. ELLIOTTII, Chapman, Flor. South. St. 494: caulibus (1–2-pedalibus) cæspitosis erectis folia tenuia longe excedentibus; panicula composita vel decomposita subpatente; capitulis 3–9-floris globulosis; sepalis ovato-lanceolatis acutissimis æqualibus stamina 3 tertia parte superantibus capsulam late ovatam obtusam brevissime mucronulatam 1-locularem atrofuscam lucidam fere æquantibus; antheris linearibus filamento vix longioribus; ovario ovato obtuso stigmatibus subsessilibus subinclusis fere æquilongo; seminibus oblanceolatis fusiformibus utrinque attenuatis rufofuscis areis lævibus reticulatis.

From North Carolina, *Canby*, to South Carolina, *Ravenel, Beyrich* (distributed under the name *J. acuminatus*), Florida, *Chapman*, Hb. norm. 54, Alabama, *Sullivant*, and southern Mississippi, *E. Hilgard.* — Many slender stems spring from a short rhizoma, which bears numerous long fibrous rootlets (under water?); panicle usually 3–4 inches long, with a few principal branches; fruit-heads (from the broad, blunt capsules) obtuse, 2 or $2\frac{1}{2}$ lines in diameter; flowers 1.0–1.2 lines long, greenish, turning brown; capsule usually very dark-colored and shining, rarely paler; seeds easily distinguished by their dark color and slender form, mostly 0.23–0.27 line long and one-third as much in diameter; 5 or 6 ribs quite conspicuous. This is one of our earliest species, flowering in April and May. The slender growth, the small, obtuse, dark-colored heads and dark seeds distinguish this plant at once, but whether Elliott's *J. acuminatus* is the same as this, as Chapman suggests, or whether it belongs to one of the forms of the next species, does not appear from his insufficient description.

39. J. ACUMINATUS, Michx. 1, 192, non Gray, Man., nec Auct. Amer. plur.: caulibus cæspitosis plerumque erectis; panicula effusa plus minus composita; capitulis pauci- vel multifloris pallidis sæpe demum stramineofuscatis; sepalis lanceolato-subulatis acutissimis subæqualibus stamina 3 dimida seu tertia parte superantibus; [463] antheris filamento plerumque brevioribus; stigmatibus subsessilibus ovario ovato obtuso seu rarius acutato sub-

brevioribus inclusis ; capsula prismatica mucronata seu acutata uniloculari sepala æquante seu excedente ; seminibus minutis obovatis seu oblanceolatis utrumque acutis areis lineolatis reticulatis.

Var. *α. legitimus:* caulibus (1–2-pedalibus) erectis gracilioribus ; panicula simplici composita vel decomposita patula ; capitulis pluri- seu multi-(5–12–30–50)floris demum e fusco stramineis ; floribus majoribus ; sepalis æqualibus seu raro exterioribus paulo longioribus capsulam prismaticam obtusiusculam mucronatam fere æquantibus ; antheris filamento multo brevioribus ; ovario ovato acuto. — *J. acuminatus*, Michx. 1, 192 ; La Harpe, 136 ; Elliott, 1, 409 ? Kunth, 3, 335, non Auct. Am. plur. *J. pallescens*, E. Mey. *Junc.* 31, non Lamarck. *J. paradoxus*, E. Mey. l. c. 30 ; La Harpe, 141 ; Kunth, 3, 341 ; non Auct. Am. *J. fraternus*, Kunth, 3, 340. *J. debilis*, Gray l. c. ex parte. *J. Pondii*, Wood Bot. (1861) 724.

Var. *β. debilis:* caulibus (spithameis sesquipedalibus) debilibus erectis seu decumbentibus radicantibusve ; capitulis pauci-(3–6)floris ; floribus minoribus pallidis ; capsula acuta breviter mucronata exserta. — *J. debilis*, Gray, Man. ed. 2, 481.

Var. *γ. diffusissimus:* caulibus (bipedalibus ultra) erectis paniculæ ultradecompositæ ramis numerosissimis filiformibus elongatis ; capitulis pauci-(3–7)floris pallidis ; sepalis angustioribus stamina fere duplo superantibus ; ovario acutato ; capsula lineari-lanceolata acuta calyci fere duplo longiore. — *J. diffusissimus*, Buckley, Pl. Tex. l. c. p. 9.

Var. *δ. robustus:* caulibus elatis (2–4-pedalibus) erectis foliisque elongatis robustis ; panicula ultradecomposita patula ; capitulis pauci-(5–8)floris stramineo-fuscis ; floribus minoribus ; antheris filamenta æquantibus ; capsula ovata obtusa mucronata fusca sepala acutissima paulo excedente.

All over the States, from Massachusetts southward to the Rio Grande, and westward to Missouri. Var. *α.* is the most common form found in the whole territory indicated ; var. *β.* I have only seen from New Jersey, *C. E. Smith ;* Pennsylvania, *Schweinitz, Moser, Porter ;* Ohio, *Lea ;* Kentucky, *Short* (the original of Gray's *J. debilis*) ; Mississippi, *E. Hilgard*, and South Carolina, *Ravenel*, but it is probably more extensively distributed ; var. *γ.*, northwestern Texas, *Lincecum, Buckley ;* var. *δ.*, in the Mississippi Valley from Illinois, *Geyer, Mead, Vasey*, to Missouri ! and to Louisiana, *J. Hale.* — All the forms of this species flower early in the season, according to latitude, from April to June, and shed their numerous seeds from May to July.

Through the kind liberality of Profs. Roeper of Rostock and Decaisne of Paris I have now had the oppor- [464] tunity of examining and comparing fragments of Lamarck's original *J. pallescens* and Michaux's *J. acuminatus*. The former's name refers, as Prof. Roeper informs me, to two poor (*more suo*) specimens collected by Commerson near Buenos-Ayres ; the heads are apparently 5-flowered ; the flowers, not yet open, are similar to those of our plant, but are 6-androus and pedicelled. Lamarck gives North as well as South America as the habitat of his plant, but adds that his specimens are those above noticed ; his reference to North America is evidently based on quotations from Pluk. Alm. t. 92, f. 9, and Moris. Hist. 3, sect. 8, t. 9, f. 5, which both represent rather something like *J. tenuis*. Meyer was undoubtedly misled by these references to North American localities to substitute Lamarck's for Michaux's name. La Harpe, p. 136, suggests, probably with more justice, that Commerson's plant is an immature *J. Dombeyanus*. Michaux's specimen, collected in South Carolina, is a rather small-flowered form of var. *legitimus*, such as often occur southeastward (comp. Hb. norm. 58), with only 5 flowers in a head (Michaux says 3 flowers), the (unripe) capsule being about as long as the sepals. The other synonyms of the older authors have not given any less trouble, principally because both Meyer and Kunth have described their *J. paradoxus* and *J. fraternus* with outer sepals exceeding the inner ones (a very rare case in any form of *J. acuminatus)* ; and in the former the capsule was said to be longer, in the latter shorter, than the sepals ; neither mentions the seeds. Having been able to examine a fragment of Kunth's plant, which had been sent from Boston by Boott, and is preserved in the Royal Herbarium at Berlin, I can most positively assert that it is a scanty-flowered form of what I have called var. *legitimus*, with the outer sepals very slightly exceeding the inner ones, and with a not fully ripe capsule about the length of the inner sepals. Meyer's *J. paradoxus* is more difficult to identify, because the original specimen does not exist in his herbarium ; he had examined it, as a memorandum indicates, in Hb. Lehmann, to whom it was given by Willdenow under the name of *J. polycephalus*, and preserved only a drawing of it and a rough sketch of some details. There are, however, in the sheet superscribed by Meyer *J. paradoxus*, ten dried specimens from different parts of the United States and Mexico, perhaps rather uncritically thrown together ; flowers of only one of them have been sent to me, and they belong to the ordinary form of var. *legitimus*. The figure of the original type represents a plant with a decompound panicle about 4 inches high and as wide, with numerous few-flowered heads, and leafy excrescences from some of them ; the other sketch shows an acute capsule exceeding the lanceolate-subulate sepals of *equal* length, and the inside of a valve [465] with a parietal placenta on the lower half. Meyer, therefore, had seen the ripe fruit, and could not have failed to see some seeds, unless all had fallen out ; but as they did not differ from the common form of *Juncus* seeds, he did not mention their shape, which he would certainly have done, and would have placed the plant in his second section, *Marsippospermum*, had they been at all appendiculate, as they are in the plant with us heretofore taken for *J. paradoxus*. Besides this, the latter, which is enumerated here as *J. Canadensis*, var. *longecaudatus*, never has the inner sepals shorter, but almost always longer, than the outer ones, and has rarely, if ever, as far as I am informed, those

leafy degenerations of the flower-heads so common in var. *legitimus*. La Harpe, who describes *J. paradoxus* from Pennsylvanian specimens, speaks of the sepals as being nearly equal to the capsule, and of the seeds as *ovoid*. Why both, Meyer as well as La Harpe, should have separated their *J. pallescens* or *acuminatus* from this *J. paradoxus* is not very clear; they have evidently seen very few or single specimens only, and seem to have laid too much stress on the slight difference in the length of the sepals.

The extreme forms of this variable plant might readily be taken for distinct species were the intermediate ones wanting. All the forms produce from a short rootstock few or many erect or somewhat ascending, rather weak (except in var. δ.), terete or slightly compressed stems, rarely (except in var. γ. and δ.) over two feet, and sometimes less than one foot high. The bracts are broad, membranaceous, and (the outer ones at least) awned; heads and flowers are of different sizes, but the sepals always regularly lance-subulate and very acute or almost awned, but not rigid, and, with rare exceptions, equal in length; only in some few specimens of var. *legitimus* I have seen the outer a little longer than the inner ones. Capsules as long as or longer than the sepals, pale green to straw-colored or light brownish, with parietal placentæ on the lower half of the valves. Seeds obovate or oblanceolate, acute or apiculate at both ends, 0.20–0.25 line long, the length being equal to about $2\frac{1}{2}$ diameters, of a yellowish or light brown color and apparently semi-transparent, neatly reticulated, and 6 or 7 ribs visible on one side.

Var. α. *legitimus* is the most variable of all the forms of this species, but is always readily recognized by the larger flowers, 1.5–2.0 lines long, and the ovate-prismatic obtusish mucronate capsule of the length of the sepals. Stems scarcely ever over 2 feet high; panicle as well as heads extremely variable, the former apparently more compound and the latter fewer-flowered north and eastward, while some Illinois (*E. Hall*, Hb. norm. 55) and Texas specimens ("Hog-bed prairies" on the Guadaloupe, *Wright*, Guadaloupe to Matamoras, *Berlandier* 1571 and 2556 [466] in part) have few (3–8) large globose 20–50-flowered heads. Capsule rarely exceeding the calyx, and then approaching var. β. Seeds variable within the limits of the species, slender, or sometimes thick. Hb. norm. 56 is a taller and 57 a slenderer form with fewer flowered heads, from Michigan, *Bigelow;* 58 and 59 are what Meyer named *J. paradoxus*, the former a smaller-flowered form from S. Carolina, *Ravenel*, the latter a larger-flowered one from Delaware, *Commons*.

Var. β. *debilis* is distinguished by the mostly very weak stem, $\frac{1}{2}$–$1\frac{1}{2}$ feet high, sometimes reclining, and even decumbent and rooting; panicle loose-flowered, 3–6 inches long; flowers 1.2–1.5 lines long; capsule very pale, more or less protruding beyond the calyx; seeds the smallest in the species. A rather small but rigid form comes from South Carolina, Hb. norm. 60, *Ravenel*, and a similar autumnal one, in which the heads by renewed vegetation of their axis degenerate into spikes, has been sent by the same botanist, ib. 61.

Var. γ. *diffusissimus* is stouter, 2–$2\frac{1}{2}$ feet high, with a panicle 8 or 9 inches long and fully as wide; fruit-heads 5 lines in diameter; flowers $1\frac{1}{2}$ lines, or, with the straw-colored radiating capsules, fully $2\frac{1}{2}$ lines long; seeds as in last.

Var. δ. *robustus* is a very different looking plant, which in the hot Nelumbium swamps of the Mississippi bottoms grows even 4 feet high, with a stem 3 lines in diameter and leaves in proportion, which, however, do not reach beyond the base of the inflorescence; panicle 6–10 inches long and a little less across, with fruit-heads only 2 lines in diameter; flowers smaller than in the other forms, 1.1–1.2 lines long; and capsules more obtuse than in the others, with a short mucro; seeds among the larger ones. — The specimens distributed in Hb. norm. 62 are, owing to the very dry season, not so well developed as the plant is often seen, nor did the fruit mature at all in that or the following year. It is an interesting fact observed by me for many years, that, if not in the whole Mississippi Valley, at least in this neighborhood, our ponds and lakes become lower every year, their rich vegetation is becoming extinct, and many have dried up altogether. Our beautiful Nelumbium, which twenty and ten years ago was an ornament to many sheets of water on hill as well as lowland in this vicinity, hiding them under their broad velvety leaves, and from the end of June to the middle of August dotting them with their splendid cream-white flowers, is fast disappearing in consequence of the retrocession of those waters, and with it its companions the Sagittariæ, the Spargania, the Junci, the Scirpi, the Zizania, and many of their minor attendants. But what botany and beauty loses cultivation gains, and, above all, the health of the neighborhood.

40. J. BRACHYCARPUS, n. sp.: caulibus e rhizomate crasso horizontali paucis erectis (1–$2\frac{1}{2}$-pedalibus) [467] rigidis teretibus; panicula e capitulis globosis multi-(30–50–100)-floris paucis seu pluribus simplici seu composita conferta; sepalis lanceolato-subulatis, interioribus quam exteriora multo brevioribus stamina 3 capsulamque triangulato-ovatam acuminato-rostratam unilocularem æquantibus seu paulo superantibus; antheris lineari-oblongis filamento multo brevioribus; stigmatibus subsessilibus ovarium ovatum acuminatum fere æquantibus inclusis; seminibus parvis oblanceolatis obovatisve utrumque acutatis areis lævisculis reticulatis. — *J. cryptocarpus*, Bebb in litt.

In the Mississippi Valley from central Ohio, *Sullivant*, Michigan, *Folwell*, *Bigelow*, Hb. norm. 74, and Illinois, *Bebb*, *Hall*, Hb. norm. 63, to Missouri! Kentucky, *Short*, Mississippi, *Hilgard*, Louisiana, *Hale*, and Texas, *Berlandier* 309, 313, 1569, 1573, and 2556 in part, *Lindheimer;* also, if the locality is correctly reported, near Charleston, S. C., *Beyrich* (distributed as *J. echinatus*). — Flowers in May and June, in Texas in April. — On one side this species is allied to the large-headed forms of *J. acuminatus*, and on the other much more closely to *J. scirpoides*, with both of which it has

been confounded. It has the rhizoma and the inflorescence of the latter, but its very short inner sepals and short capsule at once distinguish it from either. — Stems from 8 or 10 inches (seen mostly in Texas specimens) to 2–2½ feet high, rather rigid; heads 4–5 lines in diameter, single or 2–3 together, or more commonly 5–8, or even 10, in a short (1–2 inches long) contracted panicle; flowers 1.8–2.0, and capsule 1.2, lines long, so that, as Mr. Bebb remarks, at maturity the arid sepals, protruding over the almost hidden capsule, give the plant an appearance of sterility. Filaments twice or three times as long as the anthers. Seeds 0.20–0.22 line long, in shape like those of the last species; but the areæ are scarcely lineolate, the ribs however are crenulate, and sometimes short, transverse lines extend from them into the area. Among Linheimer's Texan specimens are some, the heads of which are degenerated into leafy excrescences.

41. **J. SCIRPOIDES**, Lamarck, Enc. 3, 267 (E. Meyer in Linn. 3, 370): caulibus (1–4-pedalibus) e rhizomate horizontali crasso albido rigidis strictis (seu raro decumbentibus) foliosis; capitulis globosis multifloris paucis seu pluribus; sepalis subulatis sæpius aristato-acutissimis demum rigidis spinescentibus; staminibus 3; capsula triangulato-pyramidata subulata uniloculari; seminibus oblanceolatis obovatisve utrumque acute apiculatis areis sublævibus reticulatis. — *J. polycephalus*, Michx. Fl. 1, 192; Pursh, Fl. 1, 237; Mey. Junc. 33.

Var. *α. macrostemon:* caulibus (1–2-pedalibus) foliisque teretibus rigidis strictis; capitulis paucioribus [468] minoribus in paniculam strictam dispositis; staminibus sepala fere æquantibus, antheris lineari-oblongis filamento pluries (quater seu ultra) brevioribus; capsula calyci æquilonga seu rarius exserta; seminibus minoribus. — *J. scirpoides*, Chap. 494, in part.

A. *macrostylus:* sepalis æqualibus seu sæpius exterioribus brevioribus; stylo elongato, capsula plerumque lageniformi. — *J. macrostemon*, Gay, in La Harpe, 140.

B. *brachystylus:* sepalis æqualibus seu plerumque exterioribus longioribus; s tylo perbrevi. — *J. echinatus*, Muhl. Gram. 207? *J. scirpoides*, Lamarck in Herb.! Gray, Man. ed. 2, 481.

Var. *β. echinatus:* caulibus (1½–3-pedalibus) foliisque teretibus rigidis strictis; capitulis paucioribus majoribus in paniculam simplicem dispositis; sepalis exterioribus plerumque longioribus stamina dimidia seu tertia parte superantibus; antheris filamento (duplo triplove) brevioribus; stylis abbreviatis; capsula sepalis æquilonga seu rarius exserta; seminibus minoribus. — *J. echinatus*, Ell. Sk. 1, 410. *J. megacephalus*, Curtis, in Bost. Jour. N. H. 1, 132. *J. polycephalus, α.* La Harpe, 140. *J. scirpoides*, Chapm. l. c. in part.

Var. *γ. polycephalus:* caulibus (2–4-pedalibus) compressis erectis seu flaccidis hinc decumbentibus; foliis a latere compressis gladiatis; panicula effusa decomposita et ultra; capitulis majoribus; stylis abbreviatis; capsula exserta. — *J. polycephalus*, Ell. 1, 409; Chapm. 494. *J. polycephalus, α.* Michx. l. c.; Pursh, l. c.; Mey. Junc. 33. *J. polycephalus, γ.* La Harpe, 140

A. *minor:* caulibus capitulisque paulo minoribus; sepalis æqualibus trinerviis; antheris filamentum fere æquantibus; seminibus majoribus fusiformibus.

B. *major:* caulibus capitulisque majoribus sepalis uninerviis exterioribus interiora tenuia superantibus; antheris filamento brevioribus; seminibus obovatis abrupte apiculatis.

A southern species, which extends northeastward as far Pennsylvania and New Jersey. Var. *α.* A. I have only seen from South Carolina, Hb. norm. 67 (the form with lobed heads), to Florida, Alabama, and Texas: *α.* B. is distributed over the whole range of the species, from New Jersey and Pennsylvania, Hb. norm. 65, to South Carolina, Hb. norm. 66, Arkansas, and Texas. Var. *β.* has been found from Maryland to Florida, Hb. norm. 68, and Texas; var. *γ.* A. from North Carolina to Florida, Hb. norm. 69, and var. *γ*; B. from the same States westward to Louisiana, Arkansas, and Texas. There must be some error in La Harpe's statement that La Pylaie found *J. macrostemon* in Newfoundland; perhaps he took the large-headed form of *J. nodosus* for it. — It flowers, according to latitude, from June to August.

I comprise under the name of *J. scirpoides* a number of forms, several of which have often been taken for distinct species. Michaux, who no doubt had seen a great deal of it in the southeastern States, had united all [469] under his *J. polycephalus*, in which he was followed by Pursh as well as by Meyer; but the earlier name of Lamarck must take precedence, though it seems to refer only to a single form, a specimen of which, brought by Fraser from South Carolina, is still preserved in his herbarium, now in the hands of Prof. J. Roeper of Rostock. This proves to be var. *macrostemon* (the form with longer exterior sepals), as has already been stated by Meyer (Linn. 3, 370). The older authors appear to have confounded it with *J. nodosus*, which latter Michaux does not seem to have known or distinguished, and which, on the other hand, is taken by Hooker in Flor. Bor. Am. for *J. polycephalus*.

All the forms of this species have compact, globose, mostly greenish heads, turning straw-color or light brown at maturity, on rigid or stout stems, rising, at least in var. *α.* and *β.*, from thick white horizontal rhizomas; those of var. *γ.* I have never seen in herbarium specimens; sheaths of the leaves, especially in *α.* and *β.*, loose and open; stamens 3, very rarely, in var. *α.*, 4 or 5 in number; seeds though differing much in form and size (from 0.2 to over 0.3 line long, and from an elongate fusiform to a thick ovate shape), with 5 or 6, very rarely 7 ribs on one side, and smooth or delicately marked areæ; these marks consist of one or a few perpendicular lines, sometimes crossed by a couple of hor-

izontal ones. — Our southern botanists will have to find out whether one or the other of these forms may not justly claim to be considered as a distinct species.

Var. *α.* is readily recognized by its wiry stem 1–2 feet high, its strictly erect panicle of a few (5–9, rarely single) small heads, 3½–4 lines in diameter, and composed of 15–30–40 flowers,[9] the stamens of which are as long as the sepals, the small anthers often protruding from between their tips; flowers 1¼–1½ lines long; seeds 0.22–0.28 line long, their length being equal to 2–2½ diameters. The form with long protruding styles has in flower a very curious aspect; in fruit it is often of a deeper brown than any other variety, and its capsules are not regularly subulate, as we find them in all other forms of this species, but oblong and rostrate, almost bottle-shaped. Another peculiarity of it is, that its heads are often lobed, as already remarked by Dr. Chapman, i. e. composed of a number (3–5–7) of smaller heads, the axillary productions of the lowest bracts of the primary head. Sometimes the panicles become larger, 6 inches or more in length, and composed of numerous heads; in some southern, especially Texan, specimens I find the inflorescence more spreading, and with somewhat larger heads, so that thus the transition [470] to the following varieties seems to be given.

Var. *β.* is 1–3 feet high, and stouter, and bears its larger heads in an almost umbel-shaped more compact panicle; heads 5–6 lines in diameter, consisting of 50–90 flowers, each of which is 1¾–2 lines long; seeds 0.22–0.25 line long, slender, their lengths being equal to 3 diameters. The inflorescence is sometimes looser and more compound, making a transition to the next.

Var. *γ.* is a very different looking plant, with a compressed, tall, often inclined and even decumbent stem, which is said to become 4 feet long; leaves laterally compressed, already described by Elliott as *gladiate*, 3–6 lines wide; panicle spreading, 8–12 or 15 inches long and about as wide, with distant, sometimes one-sided (usually called *sessile*) heads, i. e. heads from the base of which a long axillary peduncle springs, which bears a second head that often behaves in the same manner. So far both forms of this variety agree, but in the flowers and in the seeds they appear very different, and may eventually have to be separated, though our best southern botanists do not distinguish them, and seem to agree in the view that it is the rich marshy soil of their ricefields, and similar localities, which produces these "overgrown" forms. — The fruit-heads of the smaller form have a diameter of 5–6 lines, and are composed of 30 or 40 to 70 or 80 flowers; flowers, i. e. calyx, 2–2½ lines long, sepals about equal in length, and exterior and interior ones not more different in structure than is usually the case; anthers longer than in any other variety of our species, and equal to the filament; seeds the longest and most slender of all the forms, 0.30–0.33 line long, the length equal to 3 or 3½ diameters. — The subvariety *major* has fruit-heads of 5–7 lines in diameter, the long pointed capsules radiating conspicuously in all directions; 20–50 or 60 flowers, 2¼–2½ lines long, in each head; sepals very unequal in length, as well as in texture, the exterior ones triangular dagger-shaped, and at maturity indurated; the interior ones much shorter, and more or less membranaceous; seeds ovate or almost globose-ovate, obtuse, very abruptly or sometimes scarcely apiculate, 0.20–0.23 line long, the length being equal to 1½ or less than 2 diameters.

42. J. Bolanderi, n. sp.: caulibus (bipedalibus ultra) gracilibus rectis compressis; foliorum teretiusculorum striatorum vaginis longe biauriculatis; capitulis multi-(30–50)floris singulis seu paucis in glomerulum congestis seu breviter pedunculatis; florum (fuscorum) sessilium sepalis lineari-lanceolatis subulatis æquilongis stamina 3 quarta parte superantibus capsulam clavato-turbinatam obtusam mucronatam unilocularem æquantibus; [471] filamentis anthera oblongo-lineari apiculata bis terve longioribus; seminibus obovatis apiculato-acutatis areis lineolatis reticulatis.

Swamps near Mendocino City, California, discovered in October, 1865, by *H. N. Bolander*, and named for him, one of the acutest and most zealous explorers of Californian Botany. Rhizoma not seen; flattened stems very slender, terete leaves strongly knotted; mature heads 4–5 lines in diameter, brown, shining, single, or 2, or usually 3–5 together, either sessile and crowded together into a large cluster, or some of them peduncled; flowers 2 lines long, with very narrow and sharp pointed sepals, and very slender stamens; shape of capsule quite peculiar; seeds 0.25 line long, with about 8 ribs visible. The flattened stems and the brown heads assimilate this species to the Californian *Ensifolii*, but the rounded and strongly knotted leaves and the sessile flowers seem to separate it from them and place it with *J. scirpoides* and its allies.

43. J. nodosus, Lin. Sp. Pl., ed. 2, 1, 466, excl. syn.; Rostk. Mon. 38, t. 2, f. 2, excl. syn. Torr. Fl. N. Y. 2, 326, excl. var. 2; Gray, Man. ed. 2, 482: caulibus teretibus erectis e basi stolones tuberiferos emittentibus; paniculæ plerumque subsimplicis capitulis pluri- vel multifloris; sepalis lanceolato-linearibus subulatis stamina 6 fere duplo superantibus capsulam pyramidato-rostratam unilocularem æquantibus seu plerumque ea brevioribus; seminibus ovatis abrupte apiculatis lineolato-reticulatis. — *J. Rostkovii*, Mey. Junc. 26; La Harpe, Mon. 133; Kunth, l. c. 332. *J. polycephalus*, Hook. Fl. Bor. Am. 2, 190.

[9] Muhlenberg describes his *J. echinatus* with 9-flowered heads, and Lamarck his *J. scirpoides* with heads bearing 12–18 flowers.

Var. *α. genuinus:* caule humiliore (spithameo ultrapedali, rarissime elatiori) foliisque tenuibus; spatha erecta paniculam subsimplicem coarctatam (raro capitulum singulum) superante; capitulis minoribus pluri-(8–20)floris; floribus minoribus fuscatis; sepalis lanceolatis æqualibus seu exterioribus paulo brevioribus; antheris oblongis seu oblongo-linearibus plerumque apiculatis filamento brevioribus; ovario ovato stylo brevissimo coronato; capsula ovato-lanceolata rostrata plus minus exserta.

Var. *β. Texanus:* caule elatiore (pedali bipedali) foliisque tenuibus; spatha patente paniculam plerumque compositam decompositamve fere æquante; capitulis majoribus multi-(15–40)floris; floribus majoribus demum stramineis; sepalis lanceolato-subulatis exterioribus brevioribus; antheris linearibus obtusis filamento (hinc duplo) longioribus; ovario lanceolato in stylum longiorem sensim abeunte; capsula pyramidato-lanceolata subulata exserta.

Var. *γ. megacephalus*, Torr. l. c.: caule elatiore (pedali tripedali) foliisque robustis; spatha erecta seu paulo deflexa foliove summo paniculam subsimplicem coarctatam sæpius superante; capitulis magnis densissime multi-(30–80)floris; floribus majoribus virescentibus demum stramineis; sepalis lanceolato-subulatis exterioribus longioribus; antheris linearibus filamento paulo brevioribus; ovario lanceolato in stylum brevem sensim abeunte; capsula pyramidato-subulata vix exserta. — *J. megacephalus*, Wood, Bot. 724, non Curtis. [472]

This species takes a much wider geographical range than the last, including the whole of North America north of Mexico, with the exclusion of the southeastern States; but the different forms occupy different geographical regions. Var. *α.* is found throughout British North America from Canada and the Hudson Bay regions to the Rocky Mountains and the northwest coast, and extends southward to Pennsylvania, *Porter*, Hb. norm. 70, Ohio, *Lapham*, Michigan, *Bigelow*, Hb. norm. 71, and Wisconsin, *Lapham, Hale*. I have seen no specimens from further south, though the older authors credit it to Virginia and Carolina, quoting, among others, Bosc as their authority. Var. *β.* has been solely found in Western Texas, *Lindheimer*, 545, *Wright, Buckley*. Var. *γ.* meets *α.* on Lake Ontario, where also *J. alpinus* and *articulatus* join, and extends from thence westward to Michigan, *Bigelow*, Hb. norm. 74, and southwestward to Illinois, Missouri, the northern Red River, *Hubbard*, the Saskatchawan, *Bourgeau*, the Yellowstone, *Hayden*, Colorado, *Parry*, Hb. norm. 75 (a dwarfed form), New Mexico, *Fendler*, 849 *Wright*, 696 and 1926, Texas, *Lindheimer*, 546, and others; and to Arizona, *Coues & Palmer*, and California, *Coulter*, 809. It flowers from July to August.

Our plant is very closely allied to the last, and is often confounded with it; but the number of stamens and the markings of the seeds will readily distinguish any of the forms which may be mistaken for one another, e. g. *J. scirpoides, β. echinatus*, and *J. nodosus, γ. megacephalus*. Besides, the slender stolons which terminate in a chain of small bulbs, probably the only part that sustains the life of the plant during winter, are quite characteristic of all the forms of this species. Another peculiarity of var. *β.* and *γ.* is the direction of the leaves, especially the upper ones, which are patulous, making a very distinct angle with their sheathing base, while in var. *α.* the leaves are erect, forming an almost straight continuation of the sheath. Var. *α.* and more rarely var. *γ.* exhibit sometimes that degeneration of the heads into bunches of sheaths or leaves which has been spoken of in another place. The seeds are 0.22–0.27 line long, the length being nearly equal to 2, rarely to 2⅓ diameters; commonly 8 ribs are visible on one side.

The northern form, var. *α.*, is the genuine *J. nodosus* of Linnæus, who described it from specimens sent by Kalm (most probably from Canada), as Prof. Gray ascertained in the Linnæan herbarium itself. He informs me that "Linnæus' reference to Gronov. Virg. 15 [leg. 152] is a mistake, in copying from Gronovius of *Gramen junceum elatius pericarpiis ovatis Americanum*, Pluk. alm. That this is not the type of *J. nodosus* is clear, because it does not, like all other Gronovian plants, appear in the first edition of Spec. Plant. Linnæus' annotations prove that he was considering some plant in his herbarium, and not a mere quotation." The figure of Rostkovius is a very good representation of the ordinary appearance of this variety. — It is by far the slenderest form, usually from 8–12 or 15 inches high, with 2–5 or 8 brown heads in a rather compact and simple or slightly compound panicle; in the Rocky Mountains a dwarf form occurs, with a filiform stem 3–5 inches high, bearing a single few-flowered head (*J. polycephalus, γ.*, Hook. l. c.); a similar variety was collected on the mountains of Vermont by *H. Mann*, Hb. norm. 72; *Judge Clinton* and *Dr. Bigelow*, Hb. norm. 73, send from the shores of the northern lakes a taller form, 2–3 feet high, with a more compound lighter colored panicle; and this makes a transition to one which Dr. Vasey has sent from the northern border of Illinois, a stout, large (nearly 2 feet high) green-headed plant, with a decompound panicle of at least 30 greenish heads, each composed of 25–35 flowers. This latter is an interesting form, as it connects all three varieties. — The heads of the genuine *J. nodosus* are 3½–4 lines in diameter, and show a deeper brown color than any of the other varieties; the flowers are 1½–2 lines long, and the capsule, which is usually rostrate from an oblong body and not regularly subulate, in most instances considerably exceeds the sepals. The seeds are, as in all other forms of this species, ovate or obovate, abruptly apiculate, and prettily reticulated with very distinct cross-lineolation, 0.22–0.27 line long, their diameter being equal to about one-half their length, or, in some forms with slender seeds, much less. [473]

Var. *β.* is usually a taller plant, 12–20 inches high, but quite slender; the compound or decompound rather lax panicle is 2–4 inches long, and the echinate fruit-heads have a diameter of 5 or 6 lines. Flowers 2½ lines long; obtuse anthers often twice as long as the filaments; seeds usually a little smaller than in the last, 0.22–0.24 line long.

Var. γ. is a stouter plant, 1–2½ feet high, with the largest heads of any *Juncus* known to me, in fruit 6–8 lines in diameter, in a rather compact panicle; seeds like those of the last. The Texan variety and Dr. Vasey's specimens mentioned above, unite this with the genuine *J. nodosus*, from which I cannot separate it, though looking so very distinct.

44. J. CANADENSIS, J. Gay in La Harpe, Mon. 134; Kunth, l. c. 333: caulibus cæspitosis teretibus lævibus; paniculæ capitulis pauci-multifloris; sepalis lineari-lanceolatis plerumque acutis, exterioribus brevioribus [474] stamina 3 vix seu paulo superantibus; antheris oblongo-linearibus filamento brevioribus; ovario in stylum brevem attenuato, stigmatibus vix seu breviter exsertis; capsula triangulato-prismatica uniloculari plerumque exserta; seminibus oblongis seu oblongo-linearibus multicostatis plus minus caudatis.

* Formæ capitulis minoribus paucifloris.

Var. *a. coarctatus:* caulibus humilioribus (½–1½-pedalibus) erectis; paniculæ minoris coarctatæ ramis erectis; florum minorum sepalis acutis seu raro obtusiusculis; antheris oblongis filamento duplo brevioribus; capsula castanea acutata longius exserta; seminibus oblongis lineolato-multicostatis, appendicibus diametrum fere æquantibus. — *J. Canadensis*, β. Gay, l. c. *J. acuminatus*, Torr. N. Y. 2, 327; Gray, l. c. 481; Chapm. Fl. 464, et Auct. Am. plur. non Michx.

Var. β. *brachycephalus:* caulibus elatioribus (1½–2½-pedalibus) gracilibus erectis seu descendentibus; paniculæ majoris effusæ ramis patulis; florum minorum sepalis plerumque obtusis; antheris linearibus filamento brevioribus; capsula e stramineo fuscata obtusiuscula mucronata breviter exserta seminibus ut in var. *a.*

* * Formæ capitulis majoribus plurifloris.

Var. γ. *subcaudatus:* caulibus (1–2½-pedalibus) gracilibus erectis seu decumbentibus; paniculæ effusæ ramis patulis sæpe horizontalibus; capitulis pluri-(8-20)floris; florum majorum sepalis acutissimis; antheris oblongo-linearibus filamento multo brevioribus; capsulis demum stramineis plerumque acutatis exsertis rarius mucronatis subexsertis; seminibus oblongis reticulato-multicostatis in appendices perbreves attenuatis.

Var. δ. *longecaudatus:* caulibus (1½–3-pedalibus) erectis robustis rigidis; paniculæ abbreviatæ seu patulæ capitulis pluri-multi-(5–8–20–50–90)floris; florum majorum sepalis acutis seu rarissime obtusiusculis; antheris oblongis sæpe mucronatis filamento plerumque duplo brevioribus; capsulis prismaticis obtusis mucronatis seu rarius acutatis sæpe fuscatis sepala excedentibus seu rarissime æquantibus; seminibus oblongis seu oblongo-linearibus lineolato-multicostatis, appendicibus diametro longioribus. — *J. Canadensis*, *a.* Gay, l. c. *J. polycephalus*, β. *paradoxus*, Torr. N. Y. 2, 327. *J. paradoxus*, Gray, l. c.; Chapm. l. c. et Auct. Am. plur., non Meyer.[10]

This species inhabits the eastern parts of North America and extends westward in the region of the Great Lakes to the Upper Mississippi and down to central Illinois, and again in the Gulf States to Louisiana, leaving out the central States of the Mississippi Valley, to which it seems to be a stranger. It flowers in July and August, [475] when *J. acuminatus*, with which it might be confounded, has already shed its seeds. — Var. *a.* is decidedly the most northern form of this species, which extends from the northeastern States to Canada and the Lake Superior region, Hb. norm. 76 and 77, and southward to Pennsylvania, where Prof. Porter finds it in the neighborhood of Lancaster; Dr. Chapman gives Georgia as the southern limit of "*J. acuminatus*," but I have seen no specimens from those southern parts. — Var. β. has been observed from Pennsylvania, *Porter*, to western New York, *Gray, Sartwell, Vasey, Clinton*, central Ohio, *Sullivant*, central Illinois, *Hall, Brendel*, Michigan, *Bigelow*, Hb. norm. 76, and Wisconsin, *Lapham*. — Var. γ. is a form of the Atlantic States, found from Connecticut, *Eaton*, to New Jersey and Pennsylvania, *Durand, Smith*, Hb. norm. 81, *Leidy, Porter*, Hb. norm. 80, Delaware, *Commons*, Hb. norm. 82, District of Columbia, *Bebb*, South Carolina, *Nuttall*, and Georgia, *Beyrich* (distributed by him under the name of *J. acuminatus*). — Var. δ. is the most common of all the forms, extending over the whole region, with the exception, perhaps, of its northeastern extremity. I have not seen any specimens from Canada, or from the States north of Massachusetts. The Herb. norm. contains different forms of this variety; from Michigan 84, Pennsylvania 83, Maryland 88, and South Carolina 85, 86, and 87.

The different forms of this intricate species are as wide apart in habit, as well as in artificial characters, as they possibly can be, but are connected by insensible transitions, so that even the different varieties cannot always be kept clearly distinct. Its synonymy is in some confusion. It is quite impossible that specimens of so wide-spread and so easily accessible a species should not have been obtained by collectors long since, and we do indeed find such among Michaux's (La Harpe, l. c.) and among Schweinitz's plants, and no doubt in many other old herbaria; but, somehow or other, its striking diagnostic characters were overlooked, and it was thrown together with other species, such as the similar looking *J. acuminatus*, especially its var. *legitimus*, under the name of *J. polycephalus* or *J. verticillatus* (lege *subverticillatus*). — This and the following two species are well distinguished from all the other articulate ones by their tailed seeds and by the proportions of their usually strongly nerved sepals, the inner of which always exceed the

[10] This arrangement of the varieties differs somewhat from that previously adopted by me on p. 436, and in some herbaria labelled by me. No confusion will arise from this if the reader will only substitute "*brachycephalus*" for *brevicaudatus patulus*.

outer ones. From its two allies it is distinguished principally by the shape and proportion of its capsule, and the smaller and differently shaped seeds.

Varr. *a.* and *β.* are distinguished from the others by their small, usually 3–4-flowered heads, smaller flowers, which are 1¼–1½ and, only in Lake Superior specimens of *a.* 1¾ lines long, and the form of the smaller seeds. [476] These seeds are 0.25–0.33 line long, 2½ diameters being equal to the length ; appendages about equal to the diameter, so that the whole seed has a length of 0.40–0.60 line ; 7–9 ribs visible, connected by delicate cross-lines.

Var. *a.* is readily known by its low stature, rarely over a foot high, erect, dark colored panicle (1–4 inches long and ¾–1½ inches wide) and elongated capsules, and therefore longer fruit-heads ; the sepals are usually acute, but in some forms from Pennsylvania and from New Hampshire I have found them obtuse. American botanists have usually taken this form for *J. acuminatus*, Michx. ; but Michaux's plant is very different and, moreover, comes from South Carolina, while the present variety is, I believe, not found south of Pennsylvania. Prof. Porter gets in the mountains of that State a low form with more patulous lighter colored panicles, and more obtuse sepals, Hb. norm. 78, which seems to form a transition to the next variety.

Var. *β.* stands in habit and stature nearest to var. *γ.*, but its small, short heads, obtuse sepals, and short capsules distinguish it at once from that and from var. *a.* ; our botanists have sometimes confounded it with *J. debilis* or with *J. articulatus*, from both of which however the characters enumerated readily distinguish it. Stem 1½–2½ feet high ; panicle 4–9 inches long and proportionately wide. Mr. C. E. Smith gets a form at Tinnicum, near Philadelphia, which unites this with var. *γ*, having the seeds of this, but the greater number of flowers (10–12), the larger heads, and the pointed sepals, of the other.

Var. *γ.* is a rather rare plant, and does not seem to have attracted the attention of botanists, although it had been collected, especially about Philadelphia and in New Jersey, until Mr. Bebb of Washington and Mr. Smith of Philadelphia studied it with a great deal of attention. The shortness of the appendages had induced some to place it away from its close alliances and with or near *J. acuminatus*, but I cannot entertain any doubt but that it is so closely allied to var. *δ.* that it can barely be kept apart from it, the length of the appendages being quite variable even in seeds from the same capsule. The whole plant, however, is more delicate, lighter green ; the stem weak, and more usually decumbent ; the panicle very loose, commonly with long and often horizontally-spreading slender branches ; heads pale, 8–15–20-flowered ; flowers as large as in the next, 1½–2 lines long ; sepals always subulate and very acute, and often only 1-nerved ; capsule more commonly acute or acutate, as long or mostly longer than the sepals ; seeds 0.25–0.36 line long, thicker than in the next variety, the length being equal to 2–2½ diameters ; seed with appendages 0.33–0.50 or very rarely 0.60 line long ; appendages less than the diameter of the seed, often only half as long ; 7–8 [477] ribs visible, usually very distinct, with cross-striation and an approach to reticulation.— A slender form is distributed in Hb. norm. 80 and 81, a more rigid one is Hb. norm. 82, but both run together.

Var. *δ.* is the most polymorphous of all the forms of this species ; it is stouter, taller, and more rigid than the other varieties, and thus approaches more nearly to the following species. The panicle 3–6 or sometimes as much as 9 or 10 inches long, and 2–5–7 inches wide, with somewhat spreading but rarely horizontal rays, is either much branched and bears smaller (5–8–20-flowered) but more numerous heads, or it is more simple, with larger (30–40 and in some Delaware specimens even 80 or 90-flowered) and fewer heads ; it is usually loose, but sometimes quite compact ; specimens from South Carolina, Hb. norm. 85, have large green heads in a decompound panicle. Flowers 1½–2 lines long, greenish, at last with the capsules light brown ; sepals generally 1–3 or sometimes 5-nerved, very acute, or rarely somewhat obtusish, usually quite unequal, or as an exception, nearly equal in length ; capsule prismatic, and usually obtusish and mucronate, as long as or mostly longer than the sepals, sometimes acutate and elongate. Seeds slender, and either large with shorter appendages, or smaller and thinner and with longer tails; the former are 0.30–0.46 line long, length equal to 2½ diameters, with the appendages 0.60–1.00 line long ; the more slender seeds are of the same total length, but the body of the seed is a little shorter (0.25–0.35 line long) and its length is equal to nearly 3 diameters ; 8–10 or 15 ribs or striæ are visible on one side of the seed. — A curious form with branched heads, the single branches being elongated into spikes, was found by A. Commons near Salisbury, Maryland (see p. 427). Mr. Ravenel has collected this species in South Carolina with often more than three stamens : Hb. norm. 87. — This variety is the plant which by most American botanists has been taken for Meyer's *J. paradoxus ;* but I have shown above (p. 462) that Meyer's plant, *sepalis "exterioribus longioribus,"* must be what I have designated as *J. acuminatus*, var. *legitimus*, and cannot have been meant for our plant, the exterior sepals of which are *shorter*. Meyer's name was not given in reference to the curious seeds, but to the frequent foliaceous excrescences of his plant, which seem to be quite rare, if not unknown, in the present species.

45. J. CAUDATUS, Chapm. Fl. S. St. 495: caulibus (2–3-pedalibus) cæspitosis teretibus foliisque rigidis lævibus ; paniculæ compositæ seu decompositæ ramis suberectis ; capitulis pauci-(2–5)floris ; sepalis lanceolatis 3–5 nerviis, exterioribus brevibus acutis stamina 3–6 æquantibus, interioribus subulatis longioribus ; ovario linear- [478] lanceolato in stylum perbrevem sensim abeunte, stigmatibus exsertis ; capsula obtuse triangulata pyramidata

acutata atro-rubente lucida semitriloculari longe exserta ; seminibus lineari-oblongis multo-lineatis longe caudatis. — *J. erythrocarpus*, Chapm. olim in sched.

Southeastern and southern States, from South Carolina, *Curtis*, *Ravenel*, Hb. norm. 89, to Florida, *Chapman*, Hb. norm. 90, Alabama, *Bigelow*, and Louisiana, *Hale;* fl. Sept. & fr. Oct. — Similar to the next but with much smaller flowers, long protruding pyramidal capsule, slender stamens inconstant in number, and larger seeds. Rigid cespitose stems "from a thick and creeping rhizoma" (Chapman) ; panicles in most of the specimens before me 2–6 inches in length and quite contracted, the principal branch of the panicle being often strictly erect and quite elongated, — in others more open; fruit-heads 2–4 lines in diameter, with 2–4 or 5 flowers ; flowers $1\frac{3}{4}$ lines long, with very unequal strongly nerved sepals; capsule much longer, sometimes twice as long as flowers, regularly pyramidal from an oval base, deep red brown or almost black. The number of stamens is quite variable, but more frequently 3 than 6 ; in 40 flowers of eight different specimens, from all the localities mentioned above, I have found only 4 with 6, 9 with 5, 11 with 4, and 16 with 3 stamens, and in no instance did all the flowers of one plant exhibit the same number of stamens. Seeds, without the appendages, 0.45–0.50 line long, their length being equal to $2\frac{1}{2}$ or $2\frac{3}{4}$ diameters ; appendages straw-colored or white, upper one mostly as long or longer than the seed, lower one stouter and shorter, as is usually the case in the appendages of *Juncus* seeds ; whole seeds with the tails 1–$1\frac{1}{4}$ lines long ; striæ of seed very numerous and close. — This may possibly be the same as *J. trigonocarpus*, Steud. Glum. 2, p. 308, of which I have not been able to obtain a specimen or a satisfactory description.

46. J. ASPER, n. sp. : caulibus (bipedalibus et ultra) cæspitosis teretibus cum foliis papilloso-asperatis ; paniculæ compositæ seu decompositæ ramis erecto-patulis ; capitulis pauci-(2–6)floris; sepalis late lanceolato-subulatis rigidis multinerviis lævibus, interioribus longioribus stamina 6 duplo superantibus ; antheris late linearibus filamentum late subulatum fere æquantibus ; ovario lanceolato in stylum eo breviorem abeunte, stigmatibus exsertis ; capsula ovato-oblonga sursum triangulari rostrata rufo- vel virescenti-fusca lucida semitriloculari sepala vix excedente; seminibus majusculis ovato-oblongis costato-lineolatis longe caudatis.

Thus far only in New Jersey, where it was found many years ago, at Quakerbridge, *Pickering* in Hb. Ac. Philad., *Durand;* rediscovered within the last few years "in a sphagnous swamp at Griffith's $6\frac{1}{2}$ miles southeast of Philadelphia, where it grows with several forms of *J. Canadensis*," *C. E. Smith*, Hb. norm. 91 ; also at [479] Quakerbridge, *C. F. Parker;* flowering in August and in fruit in September. — An interesting and well-characterized species, closely allied to the last ones, with which it has in common the longer inner sepals and the tailed seeds; distinguished from them by its rough stem and leaves, its large flowers with 6 large stamens, and its large dark seeds with (usually) purplish tails. — Roughness is a rare character in the genus *Juncus*, which I find noticed only in the South American *J. rudis*, Kunth, and the Portuguese *J. rugosus*, Steud. ; in these the flowers are smooth just as in our species, while in *J. falcatus* the stem and leaves are smooth and only the flowers rough (see p. 452). All parts of this plant are very rigid, the stems $1\frac{3}{4}$–$2\frac{1}{2}$ feet high, the panicle 2 or 3–6 or 7 inches long, less in expansion ; fruit-heads 4–6 lines in diameter, usually with 3–5, sometimes only with 2 flowers; flowers $2\frac{1}{2}$ lines long or more ; capsule equalling or scarcely exceeding the rigid and sharp-pointed green or darkish tipped sepals ; outer sepals indistinctly 5-nerved, inner ones (at least in the dry state) strongly 7-nerved ; capsule tough and hard, reddish or greenish brown, at base completely, upwards partially 3-celled ; seeds 0.5–0.6 line long, their diameter being nearly equal to half their length, the lower appendage thick and usually short, the upper one not quite as long as the seed itself; whole seed, with the tail, about $1\frac{1}{4}$ lines long; side of seed with 12 or 14 ribs, and usually distinctly cross-lineolate.

47. J. MERTENSIANUS, Bong. Veg. Sitch. in Mem. Ac. St. Petersb., ser. 6, vol. 2 (1833), 167, ex Kunth, l. c. 361: caulibus e rhizomate crasso repente cæspitosis humilioribus (spithameis pedalibus) compressis debilibus ; vaginis foliorum averse compressorum auriculatis ; floribus pluribus (15–25) fusco-atris pedicellatis in capitulum laxius singulum seu rarius bina ternave aggregatis spatha brevioribus ; sepalis ovato-lanceolatis, exterioribus acuminato-subulatis, interioribus plerumque paulo brevioribus obtusis mucronatis seu rarius exteriora æquantibus acutis, stamina (3–6) superantibus capsulam late obovatam obtusam mucronatam æquantibus seu superantibus; antheris oblongis seu oblongo-linearibus sæpissime mucronatis filamentum æquantibus seu eo brevioribus; stylo quam ovarium obtusum plerumque breviore ; seminibus oblanceolato-obovatis fusiformibus utrumque breviter caudatis reticulato-costatis, areis lineolatis. —*J. ensifolius*, Hook. Fl. Bor. Am. 2, 191; Gray in Pl. Hall & Harb. l. c.

Var. β. *paniculatus:* caule elatiore (ultra-bipedali) ; vaginis vix auriculatis ; capitulis (6–9) minoribus (10–15-floris) in paniculam compositam dispositis.

From the islands of the Northwest coast, Sitcha, *Mertens*, Unalaschka, *Chamisso*, to the Cascade Moun- [480] tains, *Lyall*, and Rocky Mountains, *Drummond*, Big Horn Mountains, *Hayden*, Medicine Bow Mountains, *H. Engelmann*, and southward to Colorado, *Hall & Harbour*, 565, Huerfano Valley, *C. C. Parry*, and to the Californian Sierras, *H. Bolander*, at the Mono Pass, Hb. norm. 92; var. β. in the northern Rocky Mountains, *Bourgeau*.

With some hesitation I refer the Rocky Mountain plant, of which I have numerous and well-preserved specimens before me, to *J. Mertensianus* of the Northwest coast, the authentic specimens of which, at my disposal, are

rather incomplete; but they are distinct enough to prove Meyer wrong in referring the Sitcha plant to his *J. falcatus* (Ledeb. Fl. Ross. 4, 228). Bongard, to be sure, describes the leaves as flat, but they are not adverse like those of *J. falcatus*, but averse like those of *J. xiphioides*, and besides, are slightly but distinctly knotted.

Stems 7–14 inches high, compressed, but not ancipitous except in var. β., "weak and flaccid" (Hall), grooved below, smooth upwards; leaves, as in all its allies, of very different width, usually ½–1 or rarely 1½, but in β., 1½–2½ lines wide; heads 4½–6 lines in diameter; flowers very distinctly pedicelled, 1¾ to (commonly) 2 lines long; inner sepals, as in this whole section, quite variable, obtuse to acute and even acuminate, usually shorter, but in some flowers of the Sitcha specimens even longer than the outer ones. Stamens ⅔ or ¾ the length of the sepals, usually 6, but sometimes 3 (3 Bongard; 4–5, Kunth) in Sitcha and Cascade Mountain specimens, 6 in all those from the Rocky Mountains or California, which I have examined; anthers as long as or usually shorter than the filament, often apiculate. Ovary as well as capsule broadly obovate and obtuse. The seeds make a near approach to those of the last section, their appendages being sometimes quite conspicuous; in Hall's Colorado specimens I find them usually very short, while in a specimen of Dr. Hayden's they are almost equal to the diameter of the seed; the seed itself is 0.23–0.30 line long, the length being equal to 2–2½ diameters; with the appendages they are 0.30–0.35, and in the above-mentioned specimen of Dr. Hayden even 0.50 line long; 7–9 and in some Rocky Mountain specimens (*Drummond, Hall*) 9–12 ribs are visible on the side; the surface is regularly reticulated with more or less distinct cross-lineolation.

Var. β., with its tall stem, long and broad leaves, and a panicle of 3 inches in length, looks quite distinct from the ordinary form, but I cannot find any more essential differences.

This species with the four following ones, the Mexican *J. brevifolius*, Liebm., and the Asiatic *J. Leschenaultii*, Gay, form a very natural group, united by characters as well as geographical range. Their compressed [481] or ancipitous stems usually come from a creeping rhizoma, and bear laterally compressed or averse equitant leaves, which in the larger forms resemble greatly those of *Sisyrinchium* and other iridaceous plants, and which are very imperfectly septate or articulate; their sheath sometimes terminates with two auriculæ or stipular appendages, or frequently, and in the same species, imperceptibly runs out into the edge of the leaf. The flowers, always pedicelled, are brown, mostly deep chestnut, rarely greenish or paler, and are arranged in few or many-flowered heads; in many species we find forms with single or few large heads in clusters, and others with numerous small heads disposed in compound panicles. The sepals are mostly broad, the outer ones acute or acuminate, the inner ones often shorter and obtuse, rarely longer, often variable even in flowers of the same head. The number of stamens also varies in the same species. The style is distinct, either short, or sometimes very long. The mucronate capsule is about as long or rarely longer than the calyx, nearly one-celled. Seeds reticulate, with smoothish or lineolate areæ. They inhabit the western slope of North America and extend to the Asiatic side of the Pacific.

48. J. XIPHIOIDES, E. Meyer, Syn. Junc. 50 et Rel. Haenk. 1, 143; Kunth, l. c. 331: caulibus (1–4-pedalibus) e rhizomate crasso repente erectis ancipitibus; capitulis pauci- vel multifloris paucis plurimisve; floribus pedicellatis; sepalis lanceolatis subulato-acuminatis æqualibus seu interioribus obtusioribus brevioribus stamina 6 seu raro (in var. ε.) 3 fere duplo superantibus capsulam prismaticam acutam mucronatam hinc rostratam plerumque æquantibus; antheris oblongo-linearibus filamentum fere æquantibus; ovario ovato in stylum breviorem attenuato, stigmatibus subexsertis; seminibus ovato-oblanceolatis utrumque apiculatis lineolato-reticulatis.

Var. α. *littoralis:* caulibus robustis elatis (2–4-pedalibus); foliis latis iridaceis, vaginis sæpius inappendiculatis; paniculæ sæpe supradecompositæ capitulis pauci- vel pluri-(3–20)floris e stramineo fuscis; sepalis subæquilongis capsula acuta seu rostrata vix brevioribus; antheris sæpe apiculatis filamento paulo longioribus; seminibus oblanceolatis. — *J. xiphioides*, Mey. l. c.

Var. β. *auratus:* caulibus gracilibus elatis (3-pedalibus ultra); vaginis in folia latiora sensim excurrentibus; paniculæ supradecompositæ capitulis pauci-(5–10)floris stramineis nitentibus; sepalis æquilongis capsula rostrata brevioribus; seminibus ut supra.

Var. γ. *montanus:* caulibus humilioribus (spithameis sesquipedalibus); foliis angustioribus basi plerumque auriculatis; capitulis pauci-(3–10)floris pallidioribus pluribus paniculatis seu paucis (raro singulis) pluri-(12– [482] 20) vel multi-(20–50) floris fuscis; floribus paulo minoribus; sepalis interioribus brevioribus plerumque acutis, exterioribus capsulam longe mucronatam æquantibus; seminibus ut supra. — *J. xiphioides*, Torr. Bot. Mex. Bound. 222; Gray, Pl. Hall & Harb. l. c.

Var. δ. *macranthus:* caulibus mediis (sesqui-bipedalibus); vaginis in folia angustiora sensim excurrentibus; capitulis paucis multi-(18–40)floris; floribus majoribus fuscis; sepalis fere æquilongis, interioribus sæpe obtusiusculis capsulam acutam æquantibus; seminibus majoribus obovatis abrupte apiculatis. — *J. polycephalus*, α. ex parte, Hook. Fl. Bor. Am. l. c.

Var. ε. *triandrus:* caulibus humilibus seu mediis (spithameis bipedalibus); vaginis in folia angustiora sensim excurrentibus; capitulis singulis paucisve multi-(15–30)floris seu pluribus pauci-(5–8)floris paniculatis; floribus majoribus atrofuscis 3-andris; sepalis æquilongis seu interioribus obtusioribus subbrevioribus capsulam mucronatam æquantibus seu ea brevioribus; seminibus fere ut in var. α. — *J. ensifolius*, Wickstr. in Act. Holm. 1823, II. 1; Kunth, l. c. 337.

On the Pacific slope of the continent from southern California to Unalaschka, extending eastward into the plains east of the Rocky Mountains. Var. *α*. seems peculiar to the fertile lands of the California coast region: Monterey, *Haenke*, San Francisco, *Bolander*, *Kellogg*, Hb. norm. 93, Fort Tejon, *Xantus*. Var. *β*. has been found on Monte Diablo, near San Francisco, *Brewer*, Calif. St. Surv. 338. Var. *γ*., the large-headed form in the Rocky Mountains, from Oregon, *Spalding*, *Lyall*, to Colorado, *Hall & Harb*. 564, and N. Mexico, *Fendler*, 858, *Wright*, 1925, and into the plains, Saskatchawan, *Drummond*, and Ft. Riley, *H. Engelmann*; the small-headed form is of more southern origin — Arizona, *Coues & Palmer*, 70, N. Mexico, *Wright*, 1923 in part, and west Texas, *Lincecum*. Var. *δ*. only in Unalaschka, *Eschscholtz*, on the "Northwest coast," *Douglas*, and in the Cascade Mountains, *Lyall*. Var. *ε*. from Unalaschka, *Eschscholtz*, *Chamisso*, *Mertens*, to the Cascade Mountains, *Lyall*, and the Californian Mountains, *Bolander*, Hb. norm. 94: the panicled form, San Francisco, *Bolander*.

This species, the type of the group of *Ensifolii*, is as variable as any of its eastern congeners, and its extreme forms are as widely apart in size of stems and leaves and of flower-heads, in their inflorescence, and even in the number of stamens, and transitions between the different varieties are not wanting; but in flower and fruit they are remarkably uniform. — The flowers are $1\frac{1}{2}$ lines long, rarely a little smaller, and only in var. *δ*. and *ε*. larger; the sepals are narrow, the outer ones always long-pointed, but the inner ones quite variable and often shorter; stamens scarcely more than half as long as sepals; seeds 0.23–0.26 line long and attenuate at least at the lower end, except in var. *δ*.; their length is usually equal to $2\frac{1}{2}$ diameters; about 8 ribs are visible on the side; the network of the surface [483] and the cross-lines of the areæ are very delicate but quite distinct.

Var. *α*. is often 4 feet high, with a stem 3 lines wide, and leaves 3 or 4 or sometimes even 6 lines broad; panicle 4–8 inches long; heads in some forms, and also in the original Haenkean specimen, few-flowered, in others many-flowered; seeds usually slender and almost fusiform. Var. *β*., similar to the last, with leaves 2–3 lines wide, is distinguished by its showy, glistening, golden straw-colored panicles, about 4 inches in length; sepals almost nerveless; capsules larger than in the other forms and longer than the sepals, thus approaching the following species. Var. *γ*., the mountain and eastern form of the species, is smaller, with fewer heads either few-flowered and in a small panicle (about $1\frac{1}{2}$ or 2 inches long), or many-flowered, 3–4 lines in diameter and 1–5 or 8 in number; leaves usually $\frac{1}{2}$ to $1\frac{1}{2}$ lines wide. Var. *δ*. may be considered a large-flowered northwestern form of the latter; flowers $1\frac{3}{4}$ lines or more in length; seeds 0.25–0.26 line long, thicker than in the other forms and with short and abrupt points. Var. *ε*., with its very flat and somewhat curved sword-shaped leaves, and usually few large dark-colored heads of triandrous flowers, looks quite peculiar, but flower, fruit, and seed are the same as in the other forms. I find plants of the same habit and with the same kind of leaves and heads among the different forms of *J. Mertensianus* and of *J. phæocephalus*, but the fruit and flowers will always distinguish them. The seeds in this variety are intermediate between those of the last and those of the other forms. — Meyer (Linn. 3, 373) describes *J. ensifolius* with an obovate obtuse capsule; I do not find it so, but suppose he had a specimen of *J. Mertensianus* in view, for which this shape of the capsule is quite characteristic.

49. J. OXYMERIS, n. sp.: caulibus (2–3-pedalibus) e rhizomate repente erectis seu ascendentibus compressis; foliis a latere compressis plus minus distincte nodosis; panicula supradecomposita patula seu stricta; capitulis pauci-(5–10)floris pallidis; floribus pedicellatis; sepalis lineari-lanceolatis acuminato-aristatis, interioribus sæpe paulo longioribus stamina 6 quarta parte superantibus capsula lanceolata rostrata uniloculari plerumque brevioribus; antheris longo-linearibus filamento duplo longioribus; stigmatibus ovarium lanceolatum apice attenuatum cum stylo ei æquilongo æquantibus exsertis; seminibus ovato-oblanceolatis apiculatis areis lævibus reticulatis. — *J. acutiflorus, floribus solito longioribus*, Benth. Pl. Hartw. 341.

Sacramento Valley, Cal., *Hartweg*, 2017, San Francisco and Mariposa, Cal., *Bolander*, Hb. norm. 95.

This species is intermediate between *J. xiphioides*, var. *auratus*, the paniculate form of *J. phæocephalus*, and [484] *J. dubius*; from the first two it is distinguished by the sharp-pointed sepals and their proportion, and the almost subulate capsule, which is similar to that of *J. nodosus*, from the first also by the long anthers, from the last by the flat leaves, and from both these by the sculpture of the seed. Sheaths of the leaves with or without auricular appendages, leaves 1–$2\frac{1}{2}$ lines wide; panicle 4–6 inches long; flowers $1\frac{3}{4}$–2 lines long, greenish straw-colored or sometimes reddish towards the tip; seeds 0.22–0.24 line long, with the ribs (7–9 visible on the side) slightly crenulate but the areæ smooth.

50. J. PHÆOCEPHALUS, n. sp.: caulibus erectis compressis apice capitulum singulum paucave multiflora seu rarissime plura minora paniculata gerentibus; foliis compressis basi auriculatis seu inappendiculatis; floribus majoribus fusco-atris pedicellatis; sepalis lanceolato-ovatis æquilongis omnibus acuminatis acutis vel cuspidatis seu interioribus obtusatis stamina 6 paulo superantibus capsulam obtusam seu acutam mucronatam subunilocularem æquantibus seu ea paulo brevioribus; antheris late linearibus filamento bis terve longioribus; ovario lanceolato in stylum æquilongum attenuato, stigmatibus elongatis exsertis; seminibus ovatis utrumque apiculatis areis sublævibus reticulatis. — *J. Rostkovii?* Meyer in Rel. Haenk. 1, 142.

Var. *a. glomeratus :* rhizomate longe repente, caule spithameo sesquipedali ; vaginis sine auriculis in folia latiora sensim excurrentibus ; capitulis multi-(15–25)floris paucis glomeratis.

Var. *β. paniculatus :* caule bi-tripedali ; vaginis foliisque ut in *a.* ; capitulis minoribus pauci-(8–12)floris composite paniculatis.

Var. *γ. gracilis :* cæspitosus caule digitali spithameo ; vaginis auriculatis ; foliis angustis seu angustissimis ; capitulis multi-(15–20)floris sæpius singulis.

California, from the sea-coast into the Sierras ; var. *a.* near the coast, from Monterey, *Haenke, Brewer,* to San Francisco, *Bolander, Kellogg,* Hb. norm. 96, and to Mendocino, *Bolander ;* var. *β.* also in the lowlands, Napa Valley, *Bigelow,* San Francisco, *Bolander, Kellogg,* Hb. norm. 97, and in the mountains, *Bolander ;* var. *γ.* in the higher mountains, about the "Big Tree Grove," *Hillebrand, Bolander,* and especially in the upper Tuolumne Valley, *Brewer,* Cal. St. Surv. 2339, 1709 and 1760, *Bolander,* 5062, Hb. norm. 98, and Mono Pass, *the same,* 6013. — All the forms of this variable species are readily recognized by their deep brown heads, large flowers, broad sepals, large conspicuous anthers, long style, and by the markings of their seeds, whatever the height of the stem, width of the leaves, or [485] nature of the inflorescence may be. — Flowers 2–2½ lines long ; sepals broad and either obtuse, or, usually, acute or acuminate and even with subulate tips, the inner ones as long as the outer ones, but often more obtusish ; anthers about 1 line (in a large-flowered specimen of var. *γ.* even 1½ lines) long, always much longer than the filament ; capsule long mucronate, scarcely exceeding the sepals, incompletely 3-celled, by the projection of the placentæ ; seeds 0.31–0.33 line long, their length being equal to 2 diameters ; 8 or 9 ribs visible ; reticulation close but distinct ; areæ smooth or marked with one or two delicate perpendicular lines, and thus similar to the seeds of *J. scirpoides,* which, however, have fewer ribs. — E. Meyer (l. c.) describes the plant very correctly, but suspecting that the flattened appearance of stem and leaves might be owing to undue pressure in drying, places it with doubt with *J. Rostkovii,* from which it is widely different.

Var. *a.* has leaves 1–2 lines wide, as long or longer than the stem ; heads large, about 5 lines in diameter, usually 2 or 3 in a cluster, or sometimes as many as 6 or 8 in a short panicle. — Leaves of var. *β.* 2 lines wide, shorter than the tall stem ; panicle loose-flowered, somewhat erect, sometimes 6 inches in length. Some of the mountain forms collected by Mr. Bolander (Yosemite Valley, Cal. St. Surv. 6036, and especially "alpine meadows," 6006, which is only a foot high) have smaller flowers 1½–1¾ lines long, and seem to approach closely to *J. oxymeris.* — Under Hb. norm. 97 two forms have been inadvertently mixed, one the real var. *paniculatus,* and the other a tall (2–3 feet high) several-headed form of var. *glomeratus.* — Var. *γ.* is a small mountain form, which with its dark heads, large flowers, and long protruding stigmas, resembles so nearly the smaller forms of *J. falcatus,* that a close examination only will distinguish them ; leaves ¼–½ line wide ; heads 4–5 lines in diameter, single or two together.

51. J. CHLOROCEPHALUS, n. sp. : caulibus (pedalibus sesquipedalibus) e rhizomate brevi repente cæspitosis erectis et foliis compressis ; capitulis multi-(15–25)floris singulis seu paucis glomeratis spatham membranaceam subæquantibus ; floribus magnis conspicue pedicellatis pallidis ; sepalis oblongis obtusis seu exterioribus et rarissime interioribus mucronatis æqualibus seu interioribus paulo longioribus stamina vix excedentibus ; antheris longe-linearibus filamento multo longioribus ; stylo ovario ovato pluries longiore exserto ; stigmata æquante vel iis longiore ; capsula ovata obtusa mucronata uniloculari sepalis breviore ; seminibus ovatis utrumque apiculatis reticulatis.

In the higher mountains of California, *Hillebrand,* Cal. St. Surv. 2338 ; dry places on peaks near Mount Dana, 10,000 ft. high, *Brewer,* Cal. St. Surv. 1804 ; along the rapid current of streamlets in Yosemite Valley, [486] 4,000 feet high, *Bolander,* Cal. St. Surv. 6033, Hb. norm. 99 ; mountains near Carson City, Nevada, *C. L. Anderson.* — Allied to the last, but readily distinguished by its pale flower heads, which look more like those of some cyperaceous plant, its broad and obtuse sepals, small ovary, very long style, shorter stigmata, and very short obtuse capsule. — The specimens before me are from 10 to 17 inches high, pale green, with the auriculate sheaths often rose purple ; leaves ½–1 line wide, like the stem compressed, but not ancipitous, shorter than the stem ; 1–3 heads, 6–7 lines in diameter ; flowers 2½ lines long, pale or whitish-green, shining ; sepals very obtuse, often mucronate or cuspidate, with broad membranaceous margins ; stamens scarcely shorter, and sometimes even a little longer, than sepals ; anthers twice to four times as long as filament, much exceeding the ovary ; style often twice as long as the ovary ; capsule, in the only fruiting specimen which I could examine, much shorter than the sepals ; seeds (immature) very similar to those of the last species, 0.32 line long and more than half as wide, 7–8 ribs visible on the side, reticulation distinct, but, as yet at least, no transverse lineolation visible.

During the two years which have passed since the first part of this paper, pp. 424–458, was published, the attention of many botanical friends has been directed to our *Junci,* and their exertions have enabled me to add several new species to the foregoing list, complete the history of others, and

make several additions and corrections. In the foregoing pages I have already acknowledged the liberality of Professors Roeper and Decaisne, who have enabled me to study the *Junci* of Lamarck and of Michaux; I have now also seen fragments of those collected by Haenke on our western coast from the Herbarium of Prague sent by Professors Kosteletzky and Von Leonhardi, and those obtained on the northwest coast by the Russian explorers, communicated by Director Regel of St. Petersburg. Thus, I believe, I have had an opportunity of examining all the original specimens of the older authors; the single *J. Pylæi*, La Harpe, from the "little island of Saint-Pierre-de-Miquelon, near Newfoundland," remains unknown to me.

The request for assistance in forming an *Herbarium Juncorum Boreali-Americanorum Normale* (p. 424) has been generously responded to by twenty-three botanists, who have sent sets of 99 plants, to be distributed by me among the great standard herbaria of this country and of Europe, and among the contributing botanists themselves. They are quoted in these pages as *Herb. norm.* or *Hb. norm.* The largest number of species were sent by Messrs. Bolander and Kellogg of [487] California, Ravenel of South Carolina, and Bigelow of Michigan, and after them by Messrs. Porter and Smith of Pennsylvania and Chapman of Florida. My own and the whole botanical fraternity's acknowledgments are due to all of them.

The 99 numbers comprise 38 different species, — among them ten described here for the first time and twelve very rare or critical ones, and twenty important varieties; the remainder consists of minor varieties, different forms of the same species or variety, and in a few instances the same plant from different localities. The specimens are not all of equal value or beauty, in some few instances they are inferior, or the different specimens of the same number are sometimes not sufficiently homogeneous for a collection that claims to be a standard one; but on the whole they will be found satisfactory, and many of them very perfect and better and more complete than they can be found in most herbaria. If my friends or the friends of botany in this country will undertake the labor of collecting and sending me specimens of the *Junci* not at all or only incompletely represented in the Herbarium Normale, I will cheerfully promise to do my best to arrange and distribute them in the same manner as in the present collection. I would, in this case, urge the importance of getting not only those species that are wanting in the Herb. Norm., but especially the intermediate and doubtful forms, that connect the different forms of such polymorphous species as *J. scirpoides* or *J. Canadensis*, and similar ones.

ADDITIONS AND CORRECTIONS.

Page 425. Among the vegetative organs, the *rootstock* has been barely mentioned, while it is a most important organ and exhibits many differences in the different species of perennial *Junci*. Very few of our species are annuals, and these all belong to the section *graminifolii: J. bufonius*, *triformis*, *Kelloggii*, and I believe, *repens*. The others bring forth buds from the axils of the lowest scaly leaves (*Niederblaetter*) at or soon after the period of flowering, and especially at the time the fruit ripens, in the form of short leaf-buds or stolons or horizontal rhizomas, which preserve the existence of the plant through winter while the old stock is decaying, and in the following season produce the new flowering stalks, and die themselves in the succeeding summer or fall when their successors are forming, so that the living part of the plant never gets more than a year old; but in most species the rhizoma, often bearing the vestiges of the decayed flowering stems, continues to exist much longer, attached to the living plant, but destitute of vitality. [488] The buds are very short and ascending in the cespitose species, *J. acuminatus*, etc.; in the creeping ones they form shorter or longer stolons, fibrous (*J. falcatus*, *J. phæocephalus*) or fleshy (*J. scirpoides*), and often bearing a bunch of leaves at their end; in *J. nodosus* the stolons form thin fibres, which bear little bulbs, and often a series of them, the source of the stems of next season (see Herb. norm. 74, where in many specimens the old withered stolons with the vestiges of the decayed stems of last season and the new ones can be seen). The species of the first section (*Junci genuini*) have stout horizontal rhizomas, and none stouter than the maritime species (*J. acutus* and *Rœmerianus*), which bear upright stems at almost every node, and not at the end like most *articulati*. Where the

internodes are short, they become cespitose, where they are long, the plants are called creeping; differences in soil and moisture, however, seem considerably to influence the length of the internodes in the same species.

Page 427. For "*J. pallescens*," wherever that name is used for one of our species, read *J. acuminatus;* for "var. *fraternus*," var. *legitimus;* for "*J. Buckleyi*," *J. leptocaulis;* and for "*J. saginoides*," *J. triformis*, var. *uniflorus*.

Page 428. The "subgenus *Juncellus*" here and p. 436 must be cancelled.

In *J. pelocarpus* and *J. acuminatus* the viviparous buds are the result of retrograde metamorphosis; in other cases they may be produced by insects, and are then much larger degenerations.

Page 430. It is evident that the sculpture of the seeds is the result of the structure of both the epidermis and the next inferior layer of cells, which both together probably constitute the *testa;* in some species it is more one, in others more the other stratum, which gives character to the appearance of the seed. My investigation of these points is not sufficiently advanced to furnish definite results; but I may state that what I have, in common with other authors, designated as the *testa*, properly seems to be the epidermis only, consisting of a single layer of cells, always larger than those of the layer under it, and never transverse. In most species the epidermis is thin, transparent, and closely adhering to the body of the seed; in others (*J. Rœmerianus*, *Balticus*, *arcticus*, etc.) it is thicker, swells up when moistened, and may then be detached; in others again, those with tailed seeds, it is quite thick and loosely adhering to the body of the seeds, so as almost entirely to obscure their proper sculpture. In the first two classes the cells of the epidermis are about as wide as they are long, and only in part correspond with the sculpture of the seed; they seem, however, to cause the markings designated by me as "levissime irregulariter reticulata" (p. 432, I.1). In the third class these cells are narrow and much elongated, sometimes as long as the seed itself, and [489] their thick walls form the ribs of these seeds.

Dr. F. Buchenau, the acute observer of the *Junci*, has published the results of his observations on the seeds of the German species in Botanische Zeitung 25, p. 201 (June 25, 1867). He generally coincides with my views; but a new term for the crossbars of the reticulated seeds, *transtilla*, seems to him necessary, and for my *semina lineolata* he substitutes the words *transverse reticulata*, which is correct in itself and was used by me p. 431 and p. 432, II. 1., but does not seem to me to express the predominant character of these seeds as well as the former term. He also minutely describes the color of the seeds, a character which I have occasionally mentioned, but which seems to be in most species too slight, and even varying, to give it much importance.

Page 432. *J. brachycarpus*, *oxymeris*, and *falcatus* ought to be classed under I. 2. For "*J. rudis*" read *J. microcephalus*. *J. dubius* comes under I. 3. *J. acutus* belongs rather between I. 1 and I. 2, and *J. Kelloggii* near *J. marginatus*, III. 1. *J. longistylis* together with *J. obtusatus* may be properly classed under I. 2. The apparent necessity of these numerous changes is a proof of the difficulty of properly classing the seeds; only completely ripe and well developed seeds ought to be used for these investigations.

Page 433. It ought to have been stated that in the systematic arrangement all the species not expressly marked as belonging to 3-androus sections, are 6-androus.

Add: 5. b. *J. Lesueurii* for subsp. *Pacificus*.

Page 434. 10. *J. Smithii* comes under 1. *Aphylli*.

Page 435. 27. *J. repens* was inadvertently classed with the 6-androus species. The *Glomeruliflori* would be better arranged thus:—

* Triandri. (No. 26 b. & c. sæpius uniflori; No. 30, 3-6-andrus.)

J. Kelloggii, n. sp. California.
J. triformis, n. sp. California.
J. repens, Michx.
J. marginatus, Rostk.
J. leptocaulis, Torr. & Gr.

* * Hexandri.

J. falcatus, Mey.
J. obtusatus, n. sp. California.
J. longistylis, Torr.

The other changes, necessary on this and the following page, the reader will please make for himself, following the text from p. 459 onward.

Page 438. *J. acutus*. The specimens said to come from New Jersey are from Z. Collins' herbarium, and are, as Mr. Durand informs me, undoubtedly of European origin; the only certain locality in North America [490] is the Californian one.

Page 439. *J. Rœmerianus*. The New Jersey locality rests on the doubtful authority of Pursh; I have seen no specimens collected farther north than Wilmington, N. Carolina, whence Mr. Canby has sent it, Hb. norm. 1.

Page 441. *J. Balticus* has been distributed in Hb. norm., viz.: 4, from Pennsylvania, *Porter;* 3, Michigan, *Bigelow;* 2, Wisconsin, *Lapham*; and 5, Californian Mountains, *Bolander*. It also occurs on the Pacific coast at least as far south as the Dalles of the Columbia, *Lyall; J. Haenkei*, Mey. Junc., p. 10, is a depauperate northern form.

Page 442. In place of "subsp. *J. Pacificus*," put:

5. b. J. Lesueurii, Bolander, in Proc. Acad. Cal. 2, 179 (1863): rhizomate repente; caulibus (2–3-pedalibus) crassioribus mollibus sæpe fistulosis; paniculæ ramis secundis; floribus (brunneo-striatis) majoribus; sepalis lanceolatis exterioribus acutissimis interiora obtusa paulo superantibus, omnibus supra capsulam ovatam vix obtuse angulatam acutam breviorem vel æquilongam conniventibus; antheris 6 late linearibus filamento brevissimo quadruplo quintuplo longioribus; seminibus magnis ovatis obtusis breviter vel vix apiculatis tenuissime irregulariter reticulatis vel læviusculis. — *J. Balticus*, Benth. Pl. Hartw. 341. *J. Balticus*, subsp. *Pacificus*, p. 442. *J. compressus*, E. Mey. Pl. Cham. in Linn. 3, 368, and *J. pictus*, Philippi, ib. 33 (1864), p. 268 (planta Chilensis).

In salt-marshes and in saline sandy soil near the coast of San Francisco Bay, *Bolander, Kellogg*, Hb. norm. 6. — Flowers July and August. — The plant certainly stands close to *J. Balticus*, but may always be recognized by the characters given above, and the habit is quite different. The stems of the larger specimens are much thicker, often 2½–3 lines in diameter, and softer; inflorescence as in all its allies very changeable, sometimes loose but more commonly compact and with strikingly 1-sided branches; flowers larger than in *J. Balticus*, 2½–3 lines long, and capsule from an oval base pointed; seeds 0.30–0.37 and in Chamisso's Chilian specimen even 0.40 line long, smoothish or usually somewhat reticulate, the network corresponding with the cells of the epidermis, which when removed leaves the seed, very similar to that of *J. Balticus*, marked with a distinct but delicate transverse reticulation; something of this is also seen on the inside of the detached epidermis, perhaps from adhering parts of the second layer of cells. *J. Balticus* has usually smaller flowers, 1¾–2 lines long, only in North Pacific specimens have I seen them nearly as large as in *J. Lesueurii;* its capsule is more prismatic and abruptly mucronate, the seeds of the same size, but (evidently owing to the greater transparency of the epidermis, which otherwise exhibits the same structure) always marked [491] with regular transverse reticulation.

Page 443. *J. effusus*. Several forms are distributed in Herb. norm.; the common one from Michigan, 7, and South Carolina, 8, and an unusually slender one, 9, from the Californian Mountains, where the common one also grows. The western botanists find in the salt-marshes near San Francisco a brown-flowered variety, which may be distinguished as var. *brunneus;* inflorescence somewhat looser and fastigiate, Herb. norm. 10, or more compact, ib. 11: other differences, if they exist, have escaped me.

J. patens was distributed by Dr. Kellogg in Herb. norm. in two forms; 12 is a tall plant with loose panicles of green flowers, 13 a low (8–15 inches high) rigid form with a more compact darker colored inflorescence.

Page 444. J. Smithii: rhizomate longe repente; caulibus (1½–2-pedalibus) gracilibus teretibus farctis siccis striulatis basi vaginis fusco-rufis breviter aristatis instructis; paniculæ laxæ vix compositæ paucifloræ spatha longissima; sepalis æquilongis, exterioribus lanceolatis acutatis, interioribus obtusis stamina 6 fere duplo superantibus; antheris oblongis filamentum æquantibus; ovario ovato in stylum brevem attenuato cum stigmatibus eo æquilongis fere incluso; cetera vide p. 444.

Found abundantly by Messrs. Smith, Porter and Leidy on Broadmountain, Pennsylvania (Herb. norm. 15), where it had been discovered by Mr. Smith a year before; also in Rausch's Gap, Lebanon county. — The very complete specimens sent by these gentlemen enable me to complete the history of this, thus far, very rare plant, which proves to be intermediate between *J. Balticus* and *J. filiformis*, with the rootstock of the former and the inflorescence of the latter, and with almost the seeds of *J. arcticus*. Seeds 0.32–0.38 line long, with short and broad appendages and a distinct rhaphe, distinctly but somewhat irregularly reticulate and partly also lineolate; epidermis easily removed after soaking.

J. setaceus: a larger and a smaller form from South Carolina have been distributed in Herb. norm. 14 by Mr. Ravenel; internodes of the creeping rhizome short, stems cespitose.

Page 445. *J. arcticus* is more closely allied with *J. Balticus* and *Smithii* than with *J. Drummondii*. More specimens obtained from the coasts of the North Pacific show that the var. *Sitchensis* is not rare there, and extends to Kamschatka; its characters hold their own well.

J. Drummondii, Californian Alps, *Bolander*, Hb. norm. 16.

Page 446. *J. Parryi:* a form with the interior sepals obtuse and much shorter than the exterior ones, which are as long as the capsule, was found by Mr. Bolander on alpine meadows, California.

Page 448. *J. stygius*, also on the north shore of Lake Superior, *O. B. Wheeler;* it seems rare everywhere, [492] so that I have not yet been able to obtain it in sufficient quantity for the Herb. norm.

J. Vaseyi. While I was deploring the destruction of Dr. Vasey's original locality, Rev. Mr. Holzer and Dr. Bigelow discovered this species in abundance in damp open woods on both sides of the river near Detroit, growing together with *J. Greenii*. Dr. Bigelow's fine specimens are distributed in Herb. norm. 17. Many of them are 2½ feet high.

Page 449. *J. Greenii.* Dr. Bigelow's Detroit specimens, Hb. norm. 19, are 2–2½ feet high, taller and stouter than those found on the coast, Massachusetts; *H. Mann*, Hb. norm. 18, Maine, *E. Tuckerman.* — Both species hold their own perfectly well, and can always be readily distinguished by the characters given above; *J. Vaseyi* is also a much more slender plant and flowers earlier, maturing its fruit, near Detroit, in the beginning of July, when the other is just in flower.

Page 450. *J. tenuis.* A form with long spathes, most specimens tall, is Hb. norm. 20, from Pennsylvania, *Porter.* Another, even taller, with the flowers often one-sided, is 21, from Illinois, *Hall;* 22 is the var. *congestus*, from California, *Kellogg*, unfortunately in too few specimens; 23 is var. *secundus*, from Pennsylvania, *Porter.*

J. dichotomus has been found as far north as Delaware and New Jersey, *Leidy*, *Commons*, *Parker*, Hb. norm. 24, and others. Mr. Ravenel sends from South Carolina a taller form, Hb. norm. 25, and a smaller, few-flowered one, 26.

Page 451. *J. Gerardii*, Massachusetts, *Mann*, Hb. norm. 27.

J. bufonius, Hb. norm. 28, is an erect form from the coast region of California, *Bolander.* — Prof. E. Hilgard found on the sandy beach of Ship Island in the Mississippi Sound the var. *fasciculiflorus* with perfectly smooth seeds; specimens of the same sent by Lindheimer from Galveston show extremely slight marks.

26. b. J. TRIFORMIS, n. sp.: caule annuo brevissimo folioso ramuloso; pedunculis capillaribus scapiformibus numerosis (½–4 pollicaribus) folia brevia filiformia supra canaliculata apicem versus plana longe excedentibus; floribus paucis capitellatis vel singulis; sepalis lanceolato-subulatis æquilongis capsulam ovatam obtusam mucronatam 2–3 locularem fere æquantibus; seminibus ovatis obtusis breviter apiculatis tenuiter pauci-costatis et transverse lineolatis.

Var. *α. stylosus:* planta major (2–4-pollicaris); capitulis 3–5-floris; sepalis stamina et capsulam longius mucronatam paulo excedentibus; antheris longe-linearibus filamento plusquam duplo longioribus; stylo ovario ovato pluries longiore exserto, stigmatibus elongatis.

Var. *β. brachystylus:* planta minor (1–2-pollicaris); floribus binis ternis rarius singulis; sepalis stamina [493] fere duplo superantibus; antheris oblongis filamento bis brevioribus; stylo brevissimo cum stigmatibus brevibus incluso; capsula calycem æquante vel vix excedente obtusa brevissime mucronulata.

Var. *γ. uniflorus:* planta minima (½–1-pollicaris); floribus bracteis 2 suffultis singulis plerumque dimeribus (sepalis 4, staminibus stigmatibus carpellisque binis). — *J. saginoides*, p. 436.

California, from the coast to the mountains; var. *α.* Yosemite Valley, alt. 4,000 feet, *Bolander*, Hb. norm. 30; flowers July; var. *β.* Ukiah, Mendocino county, *the same*, Hb. norm. 31, flowers May, also "Fort Bragg, near the coast" (1–3-flowered); var. *γ.* Sierra Nevada, among mosses, *Hillebrand;* upper Tuolumne River, *Bolander*, and in the lowlands, Anderson Valley, *the same*, Hb. norm. 32; flowers April and May.

A curious and suggestive little plant, which must considerably undermine our confidence in certain characters, considered of specific value, already shaken by the variations of other species from the same wonderful country; it proves that the singleness or plurality of flowers on the peduncle, the number of their parts, and, if my view is correct, even the proportion of stamens and styles, are not sufficient to establish specific distinction. The first points are established beyond a doubt by some of Mr. Bolander's specimens from the mountain region, intermediate between *β.* and *γ.* with one or two flowers, and often with a dimerous and trimerous one in the same inflorescence. Var. *α.* may be considered a distinct species by those that hold its differential characters to be of paramount importance; but the similarity of the whole appearance of the plants and of most of their parts, and, above all, the absolute identity of the well-marked seeds, convince me that it must be united with the others, and that eventually intermediate forms will dispel all doubts.

Only the small dimerous form was known to me when the first part of this paper went to press, and was then considered as the type of a distinct subgenus, *Juncellus*, allied through its single-flowered stems to *Rostkovia*, and distinguished by its dimerism from any other known *Juncus* (see pp. 426, 428 and 436). Mr. Bolander, however, has since discovered other forms of this plant which bear trimerous flowers, thus assimilating it to the ordinary form of *Junci* and more particularly to the European *J. capitatus*, and destroying the subgenus *Juncellus.* I am now convinced that it must be placed with its European ally near *J. marginatus*, in the section *Graminei*, the dimerous variety constituting an anomaly not otherwise observed in this genus, but again found among the allied *Restiaceæ* and *Eriocauloneæ*, where dimerism and trimerism occur in the same genus, — whether in the same species, is unknown [494] to me.

In all the forms of this little plant the leaves are 2–12 lines long and ¼ line wide, filiform, but fleshy, on their lower part strongly carinate below and grooved above, flattened towards the tip; axillary stems, or properly peduncles, with one or two leaves at their base, naked upwards and much longer than the leaves, bearing at the apex 1–5 or 6 flowers in the axils of membranaceous bracts, half as long as the sepals or smaller; flowers 1–1¾ lines long; sepals green with red, outer ones sharp-pointed, inner ones rather broader; seeds 0.23–0.28 line long, their length being equal to 1½ or 1¾ diameters; 4 or 5 faint ribs visible and between them a well-marked cross-lineolation. The central

peduncle is really terminal and bears the earliest flowers, the lowest axillary one is the next in the progress of development, and then follow the others in ascending order, so that the one next to the terminal one bears the latest flowers; in the smaller specimens the leaves of the main stem, and consequently the peduncles, are alternating, or in ½ order.

Var. *α*. is the largest one with a remarkably long style, about 3 times as long as the ovary, and much exceeding the sepals and the very long anthers; its seeds, however, are among the smallest of the species. Var. *β*. is intermediate in size between both others; when the heads bear 2 flowers, these are arranged exactly like those of *J. pelocarpus*, with 2 lower bracts, bearing the flowers in their axils, and a third sterile one at the inner base of the upper flower; sometimes this upper flower is dimerous. Var. *γ*. is the smallest one, only ½–1 inch high; its single flowers have 2 bracts at their base, just as those of any other single-flowered *Juncus*, and alternating with the exterior sepals, the stamens, carpels, and stigmas; the inner sepals and the valves of the capsule are opposed to them.

26. c. *J. Kelloggii*, n. sp.: caule annuo folioso brevissimo ramosissimo; foliis e basi vaginali latiore filiformibus supra canaliculatis; ramulis abbreviatis infra foliosis capitula laxa pauci-(3–5)flora terminalia et subinde ex axillis inferioribus pedunculos longiores bifloros gerentibus; sepalis lanceolato-subulatis æqualibus medio herbaceis stamina 3 tertia parte superantibus capsulam ovatam obtusam mucronatam tenui-membranaceam 3-locularem fere æquantibus; antheris oblongo-linearibus filamento brevioribus; seminibus ovatis vix apiculatis pauci-costatis lineolatis.

Sandy soil in San Francisco, in flower and fruit in April, *Dr. Albert Kellogg*, for whom as the pioneer of modern Californian botany, which he investigated and elucidated, at first unaided and struggling with numerous impediments, this plant has been named. — Nearly allied to the last but differing in many striking points, this little [495] species represents a glomerule of a few lines in diameter, pushing out in all directions a number of thread-like leaves; these are 6–10 lines long, and ¼–½ line wide; the short terminal heads are quite loose, the flowers on such distinct peduncles that one would be inclined to consider them as single, if the pair of bracts were not wanting which always surround the base of single flowers in this genus; the lowest axils of a branch often produce longer peduncles, elevated above the glomerate mass, but shorter than the leaves, and bearing small heads, usually of two flowers only. Flowers pale green and whitish, and, especially the capsule, of very delicate structure, 1¾–2 lines long; seeds 0.25 line long, 1½ diameters equal to the length, similar to the seeds of the last species, but with much more prominent dark ribs, 4 of which are visible on the side.

Page 452. *J. repens*, Hb. norm. 29, South Carolina, *Ravenel*.

J. falcatus. Add: capsula sepala subæquante; seminibus lanceolato-ovatis epidermide plus minus producta subcaudatis irregulariter costato-reticulatis, areis elongatis lævibus. — Sandy soil near San Francisco, *Kellogg*, *Bolander*, Hb. norm. 40. — Ripe seeds 0.35–0.40 line long, length equal to 2 or 2½ diameters; tips slightly or rarely considerably elongated, or the upper one wanting; surface palish and shining, with a thick rather loose epidermis, the cells of which correspond with the reticulation of the seed. — A form from the mouth of the Columbia, *Douglas*, communicated by Dr. Hooker, has an obtuse capsule and thick ovoid seeds. — The differences between this and what I have named *J. Tasmanicus* (p. 453, note) seem to be almost too slight to be of specific value.

Mr. Bolander sends from sphagnous swamps near Mendocino, California, a form which may be distinguished as var. *paniculatus;* analogous to the paniculate forms of *J. phœocephalus* and others; the heads of the simple or somewhat compound panicle are about 5-flowered; Hb. norm. 41, not yet in bloom in May; no stipular appendages at the base of the leaves. Maturer specimens would be desirable.

Page 453, no. 28. b. J. OBTUSATUS, n. sp.: rhizomate repente stoloniformi; caulibus (spithameis) erectis lævibus plerumque 1-foliatis folia linearia plana tenuia fere æquantibus; capitulis pauci- seu pluri-floris paucis in paniculam simplicem dispositis; floribus minoribus virescentibus extus leviter scabrellis pedicellatis; sepalis ovatis æqualibus, exterioribus sæpe cuspidatis, interioribus obtusissimis capsula ovata obtusa brevissime mucronulata 3-loculari multo brevioribus; staminibus 6 dimidia sepala superantibus ovarium obtusum cum stylo breviore æquantibus; stigmatibus elongatis exsertis; seminibus ovatis obtusis seu vix apiculatis reticulatis.

Near the Big Tree Grove, Mariposa, California, growing in large tufts, 2–3 feet in diameter, on the sandy [496] banks of streamlets, alt. 6,500 feet, *H. Bolander*, flowers in July. — In many respects intermediate between the foregoing and the following species, this plant is distinguished from both by its small obtuse flowers, green with light brown margins (1½, or in fruit nearly 2 lines long), the elongated obtuse capsule, and above all by the distinctly reticulated almost obtuse seeds, which in both others are more or less pointed or even tailed and differently marked; the seeds I could examine, not quite mature, are 0.25 line long and half as much in diameter, and exhibit 8 ribs on one side; their areæ are apparently smooth.

J. longistylis, also on the Red River of the North, *Hubbard* in Hb. Lapham; Huerfano Valley of the Rocky Mountains, *Parry;* on the banks of Mono lake in the Californian mountains, *Bolander*, Hb. norm. 43. — Stem with several short leaves, always considerably exceeding the linear foliage; seeds apiculate or short tail-pointed, with a distinct white rhaphe, strongly ribbed, when not perfectly mature like those of *J. marginatus;* fully ripe seeds with very slight cross-bars and a faint transverse lineolation.

Var.? *latifolius:* caule erecto (pedali) nudo seu basi unifoliato, folia brevia lineari-lanceolata longe excedente; panicula simplici spatha membranacea rare foliacea longiori; capitulis pauci-(3–5)floris; antheris longe linearibus filamento triplo quadruplo longioribus; seminibus obovatis costato-subreticulatis.

Californian Sierras on alpine meadows or along rivulets in the Yosemite Valley, alt. 4,000 feet, Hb. norm. 46; on the upper Tuolumne, alt. 10,000 feet, and frequent on the eastern slope of the mountains, *H. Bolander.* — Easily recognized by its broad (2–3 lines wide) and short (2–4 rarely 5 inches long) light green leaves, few-flowered heads and long anthers, but probably not specifically distinct; seeds 0.25–0.30 line long, reticulate with faint cross-bars, areæ slightly lineolate or almost smooth; 7 or 8 ribs visible.

Page 454. *J. leptocaulis.* The Arkansas specimens have been collected by Dr. Leavenworth; for the Texan localities credit is also due to that ardent old gentleman, Dr. Gideon Lincecum, who, in his seventy-ninth year, still continues an active botanist, and is now seeking a new field in Mexico. — Mr. Buckley protests against the change of his and the restoration of an older manuscript name, and threatens to lay the matter before the public for arbitration, in which I wish to assist him, referring only to the remarks on page 454.

J. marginatus. Var. *paucicapitatus* ought to follow var. *vulgaris;* both are distinguished from the other variety by a more slender growth, meagre panicle, and mostly smooth edges of the leaves: in Herb. norm. only gracile forms are represented, 33 Pennsylvania, *Porter;* 34 West Canada, *Bigelow;* 35 South Carolina, *Ravenel;* var. [497] *biflorus* is a stouter plant with broader leaves, rough on the edges and a larger panicle; Hb. norm. 38 Delaware, *Commons;* 39 S. Carolina, *Ravenel.* Intermediate forms do not seem to be rare and are found in Hb. norm. 36 and 37. Characters taken from the relative length of the inner and outer sepals, or from the differences in the shape of the capsule, seem to be entirely inconstant. No species bears more abundant seed than this, but in the collections it is rarely found fully mature.

Page 455. *J. pelocarpus,* as far west as the banks of the St. Peters River, in Minnesota, *C. C. Parry.* — It seems that the plant attains its normal development and bears fruit only in a northern climate, and grows then only 4–7 or 8 inches high, Massachusetts, *Tuckerman* in Hb. norm. 45, while the proliferous forms usually become 1 or 2 feet high, New Jersey, *Smith & Leidy* in Hb. norm. 46; the interesting southern var. *crassicaudex,* Florida, *Chapman,* Hb. norm. 47, is often 2 feet or more in height and bears a very large decompound panicle, 5–9 and even 11 inches long.

A specimen of Michaux's *J. fluitans,* from his own herbarium in Paris, bears me fully out in my supposition that it is a depauperate water or mud form of this species; its short, rooting stems, about 4 inches long, bear single terminal 2-flowered heads. The flower I could examine was not fully open yet, and leaves me in doubt whether it is 3- or 6-androus. The description of La Harpe is not quite correct in so far as he attributes to the head 2 external bracts; while they have 3, as the 2-flowered heads of the regular form have, one under each flower, and a third one above the upper flower. Michaux found his plant, as Prof. O. Brunet of Quebec informs me, on the Chicoutimi, about 100 miles north of Quebec.

Page 458. *J. articulatus,* as far west as the shores of Lake Erie, *G. W. Clinton;* in Herb. norm. 48 from Western New York, *Sartwell,* and 49 from Massachusetts, *Tuckerman.* — A form with obtuse 5-flowered green heads in a spreading and often almost level-topped panicle, obtuse, mucronate sepals and obtuse short mucronate capsule, which I designate as var. *obtusatus,* has been found by Messrs. *Diffenbaugh* and *Burke* on the river banks near Philadelphia; Hb. norm. 50.

Further Additions to the Revision of the Genus Juncus (l. c. p. 590).

1. β. Juncus Cooperi, n. sp.: rhizomate . . . foliis . . . . caule (fere bipedali) robusto rigido; spatha rigida paniculam compositam strictam vix æquante; glomerulis 2–5-floris; sepalis demum induratis nervosis, exterioribus convexis lanceolatis subulato-acutatis, interioribus ovato-lanceolatis mucronatis paulo brevioribus stamina 6 vix superantibus; antheris late linearibus, filamentis brevissimis; capsula e basi ovata acutata vix angulata indurata (virescente) paulo exserta; seminibus majoribus appendiculatis costato-reticulatis.

Camp Cady, in the southern part of the State of California, *Dr. J. G. Cooper,* 1861. — A single incomplete specimen, preserved in the botanical collection of the Geological Survey of California, discovered by the zealous naturalist whose name it bears, proves this plant to be closely allied to and intermediate between *J. acutus* and *J. maritimus,* and therefore most probably leaf-bearing. The panicle is 3 inches long and 1 inch wide, green even at full maturity; flowers with the fruit 3 lines long, anthers $1\frac{3}{4}$ lines in length; seeds with white rhaphe and broad white appendages $\frac{3}{4}$ line long; marked with irregular longitudinal reticulation. *J. acutus* (also found at San Diego by Dr. Cooper) has smaller flowers of different shape, and a deep brown almost globose capsule, and smaller differently marked seeds; *J.*

maritimus, not yet found in North America, has all the parts much smaller, an ovate mucronate capsule, smaller seeds with short appendages.

J. acuminatus, var. *diffusissimus*, exactly corresponding with the Texan plant, found by the late Dr. Clapp near New Albany, Indiana, is preserved in Hb. Torrey.

The account of *Juncus* in Gray's Manual, 5 ed., 1868, 537–544 and the *Junceæ* of Watson's Botany of Wheeler's Expedition, 1878, 272–274, are omitted from the reprint, as they add nothing to this paper. — Eds.

II. ISOLATED DESCRIPTIONS.

From Bulletin of the Torrey Botanical Club.

Juncus maritimus, Lam. In your list of Junci of the New York Flora, No. 6, p. 24, you mention *J. Rœmerianus* from Coney Island. Several years ago Professor Chas. H. Peck of Albany sent me the true *J. maritimus*, Lam., as collected on that same island, in Sept., 1868, a plant which I had not before seen from any American locality. Have you compared your specimens from Coney Island well? Are they really *J. Rœmerianus*, and do both species grow there? If not, what then is the limit of *J. Rœmerianus?* Besides the minute characters of the flowers and fruit, they can be distinguished at a distance by their habit and color. *J. maritimus* has a green, contracted, and *J. Rœmerianus* a spreading brown panicle, and blooms, I believe, much earlier [1873. IV. 40].

From the Botanical Gazette.

Juncus rugulosus, n. sp. Pale green, transversely rugose and rough, stems 2–4 feet high from a stout running rhizoma, very weak, leafy; leaves septate; panicle lax, decompound, 6–8 inches long and wide; heads with hyaline bracts, 3–5–8-flowered; sepals linear-lanceolate very acute, nearly equal, the outer carinate-one-nerved, the inner 3-nerved; stamens 6, much shorter than sepals, linear anthers shorter than filaments; capsule exceeding the calyx, lanceolate, acute, 3-angled, 1-celled; seeds acute at both ends but not caudate, reticulate.

In a running streamlet at the foot of the San Bernardino Mountains, discovered by W. G. Wright, and seen there by me also in November. — With *J. asper* the only species of our flora with rough epidermis. It may be compared with loose panicled forms of *J. acuminatus* var. *debilis*, but is readily distinguished by its roughness and its 6 stamens, and then, no forms of *J. acuminatus* occur west of the great plains [1881, VI. 224–5].

Juncus canaliculatus, n. sp. A coarse plant of the section *Graminei*, 3 feet or more high, from a cespitose rootstock, with stout terete stems and numerous concave or channelled leaves, 2 or 3 of them with auricled sheaths on the stem; heads 3 to 8-flowered, on slender branches in a decompound rather contracted panicle; flowers light greenish-red, over 2 lines long; sepals of nearly equal length with membranaceous margins, inner acute, outer ones acuminate; stamens 6, two-thirds the length of the sepals, long linear red-brown anthers longer than the filaments; ovary attenuated into a slender style bearing very long exsert stigmas, 1-celled; fruit and seed unknown.

San Bernardino Mountains, at 4,000 feet alt., S. B. and W. F. Parish. Abundantly distinguished from the allied *J. marginatus*, with which it has in common the brown-red anthers, otherwise rare in the genus, by the stouter habit, the long coarse deeply channelled leaves, larger flowers, acute sepals, acuminate ovary, long style and stigmas [1882, VII. 6].

VI.

PAPERS ON YUCCA, AGAVE, ETC.

I. YUCCA AND HESPERALOE.

From Watson's Botany of the Fortieth Parallel. — Report of the United States Geological Exploration of the Fortieth Parallel. Clarence King, Geologist in Charge. V. Supplement, 496–497. Washington, 1871.

The following addition to the Catalogue of the plants of Nevada and Utah is from Dr. George Engelmann as a result of his recent study of our hitherto ill-defined and little understood species of these genera. — S. W.

YUCCA, L.

Perianth cup-shaped, of six (whitish) petal-like lance-oval acutish leaves, withering-persistent, longer than the six club-shaped filaments. Stigmas 3, more or less united. Pod oblong or cylindrical, somewhat 6-sided, 3-celled, the cells incompletely 2-celled by a partition from the back. Seeds very numerous, flat, horizontal, in 6 rows, black, with the linear straight or curved embryo diagonal, as long as the albumen. — Stems woody, fibrous, very short or rising into thick columnar palm-like simple or branching trunks, bearing persistent rigid linear or lance-linear mostly sharp-pointed leaves, with smooth, rough, or filamentose edges, and terminated by an ample compound panicle (or rarely a spike) of showy pendulous flowers, opening wide in the evening and half-closed in the morning.

§ 1. EU-YUCCA. Filaments club-shaped, obtuse, papillose-pubescent, mostly shorter than the pistil, often spreading or recurved ; anthers oblong or sagittate ; ovary prismatic or subcylindric, obtuse or narrowed into a sort of style ; stigmas elongated, bi-lobed, papillose.

* *Sarcocarpa.* Pendulous fruit fleshy and indehiscent ; thick seeds somewhat rugose, with deeply lobed (ruminated) albumen.

1. Y. baccata, Torr. *Bot. Mex. Bound.* 221. Stems none, or short, or several feet high ; leaves very thick and rigid, lance-linear, narrowed above the broad base, concave, terminating in a stout spine, with very coarse marginal fibres ; flowers panicled; petals rhombic-ovate ($1\frac{1}{4}$–$1\frac{1}{2}$ inches long) or linear-lanceolate (sometimes over 3 inches long) ; ovary attenuate into a style ; stigmas short ; fruit ovate or cylindric, long-rostrate. — From New Mexico and S. Colorado, through S. Utah, to Arizona, California, and Mexico. Northward a low plant, it becomes a tree farther south ; leaves $1\frac{1}{2}$–2 feet long, $1\frac{1}{4}$–2 inches wide. The edible sweet fruit are often called "Dates;" seeds variable in size, usually the largest in the genus, 5–6 lines wide, $1\frac{1}{4}$–$1\frac{1}{2}$ lines thick.

* * *Clistocarpa.* Fruit indehiscent, at last dry ; seeds thickish, smooth, with the albumen entire.

2. Y. brevifolia, Eng. (*Y. Draconis*, var. *arborescens*, Torr. *Bot. Whipp., Pac. R. R. Surv.* 4. 147). Tree-like, at last much branched ; the short narrow leaves crowded at the end of the branches, thick, very rigid, stout, and sharp-pointed, not narrowed above the broad base, serrulate on the margin ; panicle sessile at the end of the branches ; fruit large, 4 inches long, ovate, pointed. — Deserts of S. Utah through Arizona to S. E. California where it forms entire forests on the desert plateaus at 2–4,000 feet altitude. Often 20–30 feet high and 1–2 feet in diameter, with a thick rough bark ; leaves 4–6 inches or in younger specimens 10–12 inches long, $\frac{1}{3}$–$\frac{1}{2}$-inch wide, stiffer and stouter pointed than any other in the genus. The flower when known may make it necessary to remove it from § *Eu-yucca*.

* * * *Chænocarpa.* Erect fruit dry, septicidally 3-valved from the apex, the valves at last again divided at tip ; seed very thin, smooth, with an entire albumen.

3. Y. angustifolia, Pursh. Stems none or short ; leaves narrowly linear, scarcely narrowed above the broad base, rigid, spiny-pointed, nearly flat above, convex below, with very slender marginal fibres, $1\frac{1}{2}$–$2\frac{1}{2}$ feet long ; flowers

spiked ; petals broad-ovate, 1½–1¾ inches long ; stigmas half as long as the ovary, sessile, erect ; capsule cylindric-ovate thick, obtuse, short-pointed ; seed large (5–7 lines in diameter), with a wide margin.

Var. β. RADIOSA, Eng. Stems several feet high, with large panicles ; petals narrow lanceolate, 1½–1¾ inches long.

Western plains to Texas, Colorado, New Mexico, and into Utah ; the variety in Central Arizona, and northward to the borders of Utah. A very variable plant, which eastward toward the Mississippi and the Gulf has broader, shorter and more flaccid leaves (*Y. stricta*, Sims ?), but is always recognized by the thick never constricted obtuse capsule, and the large broad-margined seed, 5–7 lines wide. Both forms here noticed have very narrow leaves [497] the former 6 lines, the latter 4–5 lines wide. About St. George, Utah, a form occurs with leaves only 2 lines wide.

§ 2. HESPERO-YUCCA. Filaments thickened upward, acute, smooth, mostly longer than the pistil, erect ; anthers didymous, broader than long ; ovary oval, the slender style tipped with a broad short 3-lobed stigma, bearing numerous filiform papillæ ; erect capsule loculicidally 3-valved from the apex, valves entire, undivided ; seeds thin, smooth, with entire albumen.

4. **Y. WHIPPLEI**, Torr. *Bot. Mex. Bound.* 222. Stems none or short, prostrate ; leaves few, often falcate, rigid but not thick, gradually widening toward the broad base, rough on the margin, sharp-pointed, striated, glaucous, 12–18 inches long, ½ inch wide or less; flowers paniculed ; petals lance-oval, 1½–3 inches long; capsule small, ovate or obovate, obtuse; seed narrowly margined. — From N. W. Arizona to the mountains and coast ranges of S. California; it may be expected in S. Utah. Flowers very different in size, some specimens with the largest in the genus; style sometimes as long as the ovary or much shorter.

The following genus is founded on a plant from W. Texas, originally described as a doubtful *Yucca*, then as an *Aloe*, but evidently distinct from both.

HESPERALOE, ENG. N. GEN.

Perianth cylindric, of 6 (reddish) petal-like linear obtuse leaves, united at base, withering-persistent, the outer ones cucullate at apex ; filaments from a broad adnate base, subulate-filiform, of the length of the perianth, in the bud geniculate-inflexed below the tip ; anthers oblong, bifid below; ovary ovate, 3-celled, several times shorter than the filiform style; small capitate stigma exsert ; capsule 3-celled, 6-valved, with 6 rows of thin black horizontal Yucca-like seeds, and a linear diagonal embryo of the length of the albumen.— Corm bearing the Yucca-like filamentose-margined leaves and a scape, with the fascicled flowers in a spike or few-branched panicle. The leaves, pollen,[1] and seeds are those of a *Yucca*, the perigone and pistil that of an *Aloe ;* the filaments, being adnate at base and geniculate upwards, resemble those of an *Agave*.

HESPERALOE YUCCÆFOLIA, Eng. (*Yucca* (?) *parviflora*, Torr. *Bot. Mex. Bound.* 221. *Aloe yuccæfolia*, Gray. *Proc. Amer. Acad.* 7. 390.)

II. NOTES ON THE GENUS YUCCA.

FROM TRANSACTIONS OF THE ST. LOUIS ACADEMY OF SCIENCE, III. 1873, pp. 17–54.

The stately Yuccas, of liliaceous alliance and of American origin, had attracted the attention of European horticulturists long before Linnaeus classed the then known species, four in number; and, indeed, three of these were based on specimens cultivated in European gardens, two of them, *Yucca aloifolia* and *Yucca Draconis*, on the elegant and very accurate figures of cultivated plants by Dillenius, published some one hundred and forty years ago. Ever since the Yuccas have remained favorite plants in the gardens on account of their palm-like (hence *Palmilla* of the Mexicans), either frigid and pungent or gracefully curved foliage, shooting up from the ground in pleasingly regular masses, or raised into the air on simple or branching trunks, all overtopped by immense white panicles of hundreds of glorious flower-bells.

[1] The pollen-cells of *Yucca* are globose, 0.055–0.065 mm. diam. ; those of *Hesperaloe* are similar but only 0.050–0.055 mm. diam., and those of *Aloe* 0.030–0.050 mm. diam., globose when fresh, but when dry lanceolate, folded or grooved (much like those of *Hyacinthus* and many other *Liliaceæ*), slowly becoming globose when soaked.

It thus happened that these plants fell into the hands of professed horticulturists, and — perhaps because the herbaria could afford only few and very incomplete specimens — scientific botanists rather shunned them, as they did many other such plants, and notably among them the Cacti. With these they share the precious property of being easily propagated from some, perhaps a single, imported specimen; hence, the individual peculiarities of such specimens, propagated a thousand and a thousand fold in the course of a century (for most of our cultivated [18] Yuccas have been thus long in the hands of nurserymen), at last impress the observer with the dignity of specific characters. But the botanist finds it necessary to fall back on the organs of inflorescence and fructification as the only safe guide in such difficulties; here, however, the cultivated Yuccas leave us in the dark. They yield us flowers, to be sure, but we find the flowers so very similar in many species, and again so dissimilar in different forms of the same species, that evidently but little light can be obtained from their study. And the fruits? Unfortunately the Yuccas scarcely ever have borne fruit in European gardens. The difficulties are increased by the fact, that, as will be shown below, in their native homes these plants vary remarkably in the structure and the form of even their more important organs; and until fuller examination of native forms can be had we must remain in considerable doubt as to the limits of species.

My attention was drawn to this genus, when, since 1842, Mr. F. Lindheimer sent several then undescribed species from Texas, and Dr. A. Wislizenus, and after him Dr. J. Gregg and Mr. A. Fendler, others from New Mexico and Northern Mexico. A few years later the botanists of the Mexican Boundary Commission and of the Pacific Railroad exploring expeditions added to the stock of our knowledge, and within the last decade the explorers of the botany of California and of Arizona filled up some further gaps. Within the last two years an unpretending physician of South Carolina, Dr. J. H. Mellichamp, who does not even claim to be a botanist, but is imbued with arduous zeal and keen sagacity, and who lives right among the Yuccas, has wonderfully improved his opportunities, and has very greatly aided me in my investigations by specimens as well as by his observations. I may add here that also on other families of plants of his rich State, already so long and well known through the labors of a Walter and an Elliott, have his researches shed new light, as will appear in future pages of these Transactions.

Having thus been interested in the Yuccas for many years, I ever had an eye on these plants, and in my travels in Europe I neglected no opportunity to study them in the herbaria as well as in the gardens. There I was first struck with the "fact" that "Yuccas do not bear fruit." To be sure, I had seen the fruits in the Texan and New Mexican collections, and had observed the capsules in our St. Louis gardens; but I found none in Europe, or almost none, I should say, [19] for in the botanic garden of Venice I gathered the pulpy pods from a large *Yucca aloifolia*, about 15 feet high. This was the only Yucca fruit seen by me in Europe, though I have since learned that in other instances also, yet exceptionally, fruit and good seed have been produced there, principally by this same species, and very rarely by others.

The question why the flowers should almost invariably fail, had been frequently discussed and various reasons suggested, such as sexual incompleteness of the flowers or impossibility of self-fertilization of plants originating from the same stock.

I had observed that all the Yuccas which came under my notice, opened their more or less pendulous flowers in the evening, and half closed them during the following day, after which they withered.* The anthers were observed to open a little before the flowers did, and to expel a large-grained glutinous pollen, which did not seem to readily find its way to the stigma. And how is the stigma constituted? The conspicuously papillose termination of the pistil had always been considered the stigma, but closer examination showed its papillæ to be epidermidal appendages, corres-

* See notes by the author, in Bulletin Torrey Bot. Club, 1872, III. 33, 37; and Gardeners' Chronicle, July 13, 1872. — Eds.

ponding to similar ones on the filaments, and entirely destitute of stigmatic functions; never did they contribute to the development of a pollen-grain occasionally adhering to them. Dr. Mellichamp's notice of a minute drop of glutinous liquid in the tube formed by the coalescence of the so-called stigmas led me on to further experiments. That tube proved to be the real stigma, exuding stigmatic liquor, and insects (in these *night-blooming* flowers, of course, *nocturnal* insects) must be the agents which introduced the pollen into the tube. Last June, several forms of Yucca which were blooming under my windows, were carefully watched, and soon different species of beetles were found in the flowers, but not as regularly and frequently as white moths, which, usually in pairs, disported themselves in the open flowers at dusk, and were found quietly ensconced in them when closed in day-time.[1] The suspected insects were handed over to my friend, Mr. C. V. Riley, who thereupon took up the zoölogical part of the investigation, the surprisingly [20] interesting results of which are detailed by him in the succeeding paper.

GERMINATION.

The seeds of Yucca germinate easily, the cotyledon remaining partly in the ground[2] within the seed, extracting its liquefied contents, and never grows into a leaf organ; the first leaf issues from a slit in the cotyledon opposite the remnants of the seed; the succeeding six or eight leaves of the first season following in $\frac{1}{2}$ order, which, in the further growth of the plant, gradually changes to the higher orders of $\frac{3}{8}$ and further. From the nodes of the very short axis, stout white rootlets break through the back of the leaves, the first one through the back of the cotyledon, opposite the first leaf, while the original radicle withers away. The Californian *Y. Whipplei* is the only one in which the axis, together with the base of the leaves, swells up into a sort of bulb.

In the second season, a stout, cylindrical secondary axis originates from the axil of one of the earliest of last year's leaves, covered with scale-like leaf-rudiments, and eventually producing from its nodes the rootlets which are to nourish the plant. This secondary axis takes a horizontal direction in all the species I could examine, especially in the different forms of *Y. filamentosa;* only in *Y. angustifolia* I have always found it to grow straight downwards, continuing this direction through at least the third and fourth year, and perhaps longer. Some observations seem to indicate that *Y. gloriosa* develops in a similar manner. The terminal bud of this secondary axis does not seem to form leaves as long as the primary leaf-bud continues to grow, and probably not until it has produced a flowering stem, and perhaps not even then for years. At last, however, the secondary axis branches out, if horizontal, near the surface of the soil, if perpendicular, as in *Y. angustifolia*, at a certain depth, even two or three feet, below it, forming horizontal branches, and eventually sending out leafy shoots above the surface. Some species are surrounded by such offshoots, thus forming clumps or thickets; *Y. baccata, Y. gloriosa, Y. filamentosa,* behave in this way, while *Y. angustifolia* is said to do this much more sparingly, and *Y. aloifolia* quite rarely.

ROOTSTOCK.

While the rootlets of Yucca annually spring from the youngest part of the rootstock, and [21] decay again after a season, the rootstock itself increases often to a large size and irregularly branched shape. We have very few data about the form of this organ; in fact, the only definite information accessible to me has been imparted by Mr. Lindheimer, who, with persistent zeal, has

[1] "These snow-white 'millers,' which I have found in almost every flower examined, when closed in daytime, doubtless enter their 'ivory palaces' at night, and would be quite sufficient for the purpose." — Dr. Mellichamp. Later, the same correspondent adds: "Where I have found many moths last year, I noticed none or few this season. A few weeks later the plants were found without fruit, or with fruit bearing empty seeds."

[2] The very similar seeds of Agave have a very different development; in their germination the cotyledon grows into a leaf, bearing the remnants of the seed on its tip.

dug up from the often hard and stony soil of West Texas the different species accessible to him. He informed me that *Y. angustifolia* usually exhibits a perpendicular rootstock of a finger's thickness, and two or three feet long, "rising from" (it is evident from what is stated above, that it is rather "descending to") a long horizontal simple or branching part, one or one and a half inches thick, exhibiting many knobs and buds of future shoots. *Y. rupicola* has a rootstock consisting of a few thick, cylindric, horizontal branches, one to two feet long. The tree-like *Y. Treculiana* has few short, thick, club-shaped, horizontal branches to its rootstock, sometimes only a single, short, and very stout knob, which does not seem to readily sprout out. It will be interesting to study these conditions in other species in their native localities.

The rootstock of all the Yuccas is, under the name of "Amole," an important article in a Mexican household, being everywhere used as a substitute for soap, as it is replete with mucilaginous and saponaceous matter, probably a substance analogous to the saponine of the *Saponaria* root. It is curious to learn that the negroes of the coast of South Carolina repeatedly destroyed Dr. Mellichamp's carefully observed clumps of Yuccas, in order to obtain the saponaceous rootstock. How may the knowledge of its quality have reached them? Perhaps from the West Indies.

TRUNK.

The trunk of the Yuccas either remains entirely below the surface, or it takes different degrees of development above ground. Heretofore, specific characters were partly based on such differences, but we know now that only few species are regularly and always acaulescent (*Y. rupicola*), while others, when in a perfect or flower-bearing state, always have trunks (*Y. aloifolia* and *Y. Treculiana*, though this species was first described as stemless); a certain number, usually counted as acaulescent, under favorable circumstances make short trunks, sometimes of only a few years' [22] duration (*Y. filamentosa*, and still more *Y. angustifolia*), and others, again, among them most notably *Y. baccata*, are absolutely stemless near their northern limits, while the farther south we meet them the higher and more tree-like their trunk grows.

The primary axis of the Yuccas is terminated by the inflorescence, and its apex dies with it. The plant is then rejuvenated by lateral buds, either from the same axis or from the subterranean rootstock. In the first instance the buds appear about the time of the maturity of the fruit, in the trunk-bearing forms from the axils of the uppermost, in the stemless ones from those of the lowest leaves. A single subterminal bud will soon simulate the direct continuation of the main axis; several buds will produce branches in the trunk-bearing species, while in the stemless ones they will give the plant a cespitose appearance. From Dr. Mellichamp's observations, it seems that the caulescent Yuccas show certain differences in the place where the bud appears; he noticed the young bud of *Y. aloifolia*, from exactly the uppermost axil, at the base of the inflorescence, while in *Y. gloriosa* it sprung from between the uppermost and the next lower series of leaves. In a *Y. filamentosa* in my garden, I observed several buds in the axils of the highest leaves developed two years in succession, so that a short branching trunk was formed, while after the third year the vitality of this trunk seems to have died out, and the plant was rejuvenated by shoots from the subterranean rootstock. In other forms, which probably belong to the same species, I find only rarely, in very vigorous garden specimens, a bud from the uppermost axils, while almost always they branch from below the crown of leaves. But observations of this kind, relating to the biology of these plants, have been made too seldom to permit yet the deduction of general laws.

The Yucca trunk has a light fibrous wood, which exhibits distinct marks of concentric arrangement, so that in an old trunk of *Y. Treculiana*, of two and a half feet in diameter, I can count twenty layers in a space of two and a half inches, or one and a half lines to the layer; the trunks certainly grow in thickness as they get older. Another peculiarity of old Yucca trunks is their thick, corky

bark; the above-mentioned *Y. Treculiana*, sent by Mr. Lindheimer, has an irregular, rather scaly, dark gray bark of a quarter or a third of an inch thickness, resembling that of some [23] elm or willow; a trunk of *Y. aloifolia*, received from Dr. Mellichamp, is covered with a bark of the same thickness, of a deep brown color, broken up into numerous small square or angular fragments, much like that of the dogwood (*Cornus florida*). The bark of a section of *Y. brevifolia*, sent by Dr. Parry, is similar, but over half an inch thick, and still more deeply cleft. The investigations of these organizations would form a worthy subject for an experienced phytotomist.

LEAVES.

The leaves of the Yuccas are evergreen, i.e. they last at least a whole year in the low species, or several years in the arborescent ones. They are lance-linear, abruptly narrowed above a very broad, mostly membranaceous base, and usually widening again near or above the middle (some narrowed-leaved species are not contracted below the middle), and gradually, or rarely abruptly, terminate in a horny, often sharply pointed, rarely obtuse, sometimes soft and herbaceous spine, below which the tip of the leaf is more or less concave and involute. The leaves are usually more or less thick, and more or less rigid, but we find all the transitions from the stiff and sharp-pointed ("Spanish bayonet") to the soft and flaccid leaf. Their size in the different species varies from half a foot to four feet in length, and from one quarter to two and three inches in width.

The upper side of the leaf is flat (the tip excepted), or almost always more or less concave, sometimes deeply channelled, and occasionally folded or plicate. The lower side is convex, and its lower part bluntly keeled. The surfaces are smoothish or more or less rough, and this roughness is the result of the peculiar structure of the cells surrounding the stomata. The lateral walls of these cells are thickened, hard, and transparent, and somewhat elevated above the general surface; especially in the true *Y. filamentosa* the edges of the upper and lower marginal cells protrude over the stoma like minute, beautifully chiselled, conchoidal shields, sometimes almost completely covering it. In *Y. brevifolia* the edges of other cells are also apt to protrude, and, besides, numberless little knobs, similar to the marginal asperities, to be described below, increase the roughness of both surfaces. I notice the same appearance on the lower surface of the leaves of the *Y. Treculiana* and *Y. canaliculata*, and less distinctly on *Y. gloriosa*.

The color of the leaves varies from deep or fresh green through dull green to light glau- [24] cous. Of great interest and diagnostic importance is the edge of the leaf. In some species (such as *Y. aloifolia, Y. brevifolia, Y. rupicola*) it is rough, or, as it is usually termed, serrulate, and remains unaltered through life. The teeth consist of small, irregular, isolated cartilaginous knobs, each consisting of quite a large number of colorless prismatic or clavate cells, arranged in fan-shaped or straight bundles. These are the "serrulate" or rough-edged Yuccas.

Others have "smooth-edged" leaves, (*Y. gloriosa, Y. Treculiana*); the edge, at first green, and often roughened with very delicate and deciduous asperities, soon becomes discolored and brittle, and in old leaves is apt to crumble off, or sometimes to detach itself in a few short fibres, thus approaching the next form.

The "filamentose," or fibrous-edged Yuccas (*Y. filamentosa, Y. angustifolia, Y. baccata*) constitute the third class. In these the fibrous system of the leaves is much stronger and tougher than in the last, and, the parenchymatous tissue soon withering on the edge, the marcescent marginal fibres detach themselves as more or less numerous, delicate or coarse, straight or often curled threads, of a whitish or ashy or reddish color. In the young leaf they are most conspicuous, especially near the involute point of the leaf, but in old ones they sometimes become obsolete.[3]

[3] A fourth form of leaves is described in the books as having marginal spines, and *Y. spinosa*, HBK. Nov. Gen. I. 289, from Mexico, is quoted as the representative of this type. But the inspection of the Berlin Herbarium proves this to be a factitious species, made up of Yucca flowers (similar to those of *Y. Treculiana*) and the spiny leaves of *Dasylirion acrotriche*.

Some importance has been attached to the number of leaves, which in healthy plants precede the development of the inflorescence, and there really is a relative difference in this respect in different species; but specific characters could hardly be based on a condition which depends so much on external influences of soil, climate, etc. From Dr. Mellichamp's notes it is evident that wild plants, in good health, exhibit a great many more leaves than cultivated ones, and that the number not rarely rises above one hundred on one axis.

The diagnostic characters derived from the leaves must be adopted only with great circumspection. The characters of the edges of the leaves are the most constant and reliable ones, though the abundance, thickness, and, still more, the length of the fibres, vary considerably, [25] even in forms of the same species. The shape of the leaf is quite variable, and more so still its color, its thickness, its stiffness (hence its direction), and the nature of its terminal spine; broader leaves with abundant parenchyma are apt to become plicate, while in the same species leaves of stronger fibrous structure are even. The characters derived from the roughness and the peculiar structure of the stomatic surroundings, as above detailed, are also inconstant, and therefore unreliable.

INFLORESCENCE.

The inflorescence, which terminates the axis in Yucca, usually consists of a compound raceme or panicle of different dimensions, from two to three or four feet high, with differently developed lateral branches, and therefore of different shape, oval, lanceolate, or pyramidal, and in one species at least (the northern form of *Y. angustifolia*) reduced to a simple raceme or spike. This inflorescence is nearly sessile between the uppermost leaves, especially in the arborescent species; or it is raised on a longer or shorter scape, sometimes longer than the inflorescence itself, principally in the acaulescent forms. The scape bears reduced, bract-like leaves, those of the inflorescence itself usually becoming quite small and membranaceous, or, in some southern species, increasing in size, broad, concave and spathe-like, fleshy and discolored. The inflorescence is smooth or rough or pubescent, but no important value can be assigned to these differences. The pedicels are single or (on reduced branchlets) clustered, always distinct, but shorter than the flowers, curved, patulous, declined or pendulous, never, during the flowering period, erect.

FLOWERS.

The Yucca flower consists of a PERIGONE of six oval or lance-oval segments, united at base with one another, with the stamens and with the pistil, and not articulated, so that they wither after flowering without falling off. The perigone, expanding only for one evening and night, forms a shallow cup of whitish, cream-white,[4] or greenish-white color, sometimes externally tinged with purple, of two to five inches in diameter; on the following morning, the fading segments conniving, the flower assumes a globose or deep bell-shape, of one and one-fourth to three inches in [26] depth.[5] The three outer segments are usually narrower and often a little shorter, and more frequently tinged with green or red along the midrib and tip; the three inner ones are broader (except apparently in *Y. Guatemalensis*, where they are narrower), more petaloid, of more delicate texture and color, and tipped with a small bunch of short white wool. They possess a certain, usually not pleasant fragrance.

The size of the flower and even the shape of the segments is extremely variable in some of the species (*Y. baccata, Y. Treculiana, Y. rupicola*), and can scarcely be used for diagnostic purposes.

[4] The flowers of *Y. canaliculata* are described and figured in the Botanical Magazine as "straw-yellow."

[5] It is this day-time appearance which is almost always described and figured, and which gives an erroneous impression as to the form of the well-developed flower.

The six STAMENS, in two series, but of nearly equal length, are adnate to the base of the perigone, and always shorter than this, and mostly shorter than the pistil; only in *Hesperoyucca* they are longer than the latter. Straight in the bud, they are frequently more or less recurved and even uncinate *after* maturity, in some forms more, in others less; but I am not able to discover a specific character in this change of form.

The filaments are fleshy and club-shaped, and in the true Yuccas covered, especially upwards, with transparent one-celled papillæ or papillose hair; a minute point on the obtuse, sometimes slightly trilobed apex bears the introrse anther. In *Hesperoyucca* the filament is smooth, thicker upwards, but with an acute tip.

The anthers are comparatively small, 2½ or usually 3–4 mm. long; in exceptional cases, only in cultivated plants of *Y. angustifolia*, I have seen them 5–6 mm. long; they are sagittate or cordate at the base, rounded and entire or notched at tip, adnate on the back and two-celled; they open longitudinally just before the perigone expands, and contracting to one-third or less of their size and curling backwards, expel the large, comparatively scarce, globose, glutinous pollen-grains of 0.055–0.070 mm. diameter. The size and shape of the anthers seem to me to vary in the same species.

Hesperoyucca has smaller, deeply cordate, emarginate, somewhat didymous anthers, 1½–2 mm. long, and broader than long, bearing pollen similar to that of the other Yuccas.

The PISTIL in the true Yuccas is a cylindric or rather prismatic, obscurely six-sided ovary, [27] sometimes irregularly impressed and angled by the close application of the stamens in the bud, rarely attenuated at base; terminated by three more or less united stigmas, which are usually sessile, or are elevated on a style formed by the gradually attenuated upper part of the ovary. Only in *Y. Guatemalensis* the ovary is more oblong than prismatic.

The ovary consists of three carpels, opposed to the exterior perigonial lobes, forming by their connection three primary dissepiments, each one bearing on two central placentæ two series of numerous flat, horizontal anatropous ovules on very short (not long, as is sometimes stated) funiculi, separated from one another by a secondary dissepiment springing from the back of the carpel; the single ovules, however, are not separated by transverse dissepiments, as Gaertner has it.

The Yuccas with thick seeds and fleshy fruit bear thicker ovules (0.3–0.4 and even 0.5 mm. thick), those with thin seeds and capsular fruit thinner ones (0.2–0.25 mm. thick), so that to some extent, we may, from the thickness of the ovules in well-developed flowers, guess at the section to which the plant may belong. *Y. gloriosa* and *Y. Treculiana*, however, have somewhat thinner ovules than the others of their section, and in some forms, which I class with *Y. filamentosa*, I have found them occasionally as thick as these.

The three carpels are firmly united from the centre of the ovary to beyond the middle; here a thin tube, open at the base and top of the ovary, and from this to the external surface a more or less closely compressed slit, separate them. These slits open as the fertilized ovary grows, and in the fleshy-fruited species eventually form the three inner impressed sides of the six-sided pod.

The always glabrous ovary is either obtuse and abruptly terminated by the stigma (*Y. aloifolia*), or it is gradually attenuated into a conical or prismatic glabrous style, sometimes as long as the ovary itself (*Y. rupicola*), which towards the tip ends in the stigmas. This style is an organ of great variability in length and thickness, and may or may not be present in forms of the same species.

Stigmas we conventionally call the terminations of the three carpels, which are distinguished from the ovary and style by their coating of transparent oval or globose epidermidal cells, which, however, as already stated, have no stigmatic function, not even that of gathering the [28] pollen. The three stigmas, emarginate or bilobed at the summit, are more or less united, and form a tube; they are generally erect, but in some species, especially in the true *Y. filamentosa*, they are at last patulous and even recurved. The inside of the stigmatic tube, somewhat triangular in

the transverse section, with three pairs of tiny prominent ridges, corresponding to the commissures of the carpels, is coated with much smaller and less elevated, truly stigmatic cells, which exude the stigmatic liquor, under the influence of which alone the pollen can develop. The tube terminates near the upper ends of the three ovarian cells, and does communicate directly with them.

Hesperoyucca has an obovate ovary of a similar structure, crowned by a shorter or longer, sometimes filiform style, bearing a very peculiar, large, hood-shaped, trilobed stigma, beset with long filiform papillæ.

The color of the stigma is usually of a pearly white, while the ovary is dull or greenish-white; only in *Y. angustifolia* I find the stigma bright green.

FECUNDATION.

The fecundation of the Yucca flower, as has been stated in the introduction, is very uncertain, and evidently depends on contingencies not always attainable; so that very often in its native condition, and almost always in cultivation in Europe, these plants remain sterile. The flower can only be fertilized by the introduction of the pollen into the stigmatic tube. This, at least in the capsule-bearing Yuccas, which alone I have been able to examine in the growing state, is accomplished almost always by a nocturnal insect, the *Pronuba yuccasella* (thus named by Mr. Riley and described in the next paper). Even where we are unable to observe the moth itself, its traces are manifest in the presence of its offspring, the larvæ, feeding on the maturing seeds, tunnelling their rows and finally emerging through a perforation of the capsule. Wherever, therefore, we find such perforated capsules, or merely the remaining annular rim of seeds, we know that *Pronuba* has been at work. The capsules and seeds of the Californian *Hesperoyucca* also show the unmistakable traces of this or a similar insect. On an average in our gardens, as well as in the fields of the coast of South Carolina, about two-thirds of the capsules and their seeds bear the marks of these larvæ.

Of the baccate Yuccas, *Y. gloriosa* and its allies seem to bear fruit very rarely, as neither [29] my correspondents nor I myself have thus far ever been able to obtain one; *Y. Treculiana* is abundantly fertile in its native localities, but will not fructify, as Mr. Lindheimer informs me, in the gardens of the same region; *Y. aloifolia*, however, matures its pods more readily than any other species in Europe, where our moth cannot have an agency in it. We, therefore, are forced to assume that some other mode of fecundation, or even self-fertilization, can take place with them. Occasionally, no doubt, the moth performs its functions in the flowers of this species as well as in the capsular Yuccas. Dr. Mellichamp has found its larvæ tunnelling the seed rows of *Y. aloifolia*, destroying 10 to 14 seeds during its growth, and eventually emerging through the characteristic perforations of the surface. He discovered also another larva in the green pods of this species, the egg of which is evidently deposited into the rind of the ovary or young fruit, and which principally feeds on the immature pulp and only rarely attacks the growing seed. This, Mr. Riley thinks, must be the larva of a hymenopterous insect, which has, perhaps, nothing to do with the fecundation of the flower. But how may these Yuccas be fertilized without the action of the Pronuba? Probably, occasionally, and, so to speak, accidentally by other insects, or possibly sometimes by the withering and conniving segments of the flower bringing adhering clumps of pollen in contact with the stigmatic juices in the open tube. Such chances, however, seem to be slim, not to say improbable, and in this case impregnation would have to take place on the day following the opening of the flower.

It has been stated above that the quantity of pollen is small, and that the grains are large and somewhat viscid; thus, when expelled from the contracting anthers, they remain in little clumps here and there within the flowers, on the papillose filaments, or, more frequently, attached to the inner surface of the perigon. When introduced into the stigmatic tube and in contact with its secretion, its tubes are developed, and, when we carefully dissect a fertilized ovary, large bundles of

straight parallel tubes are found to fill the cells and to find their way, one to almost each ovule. I have followed them through both openings of the ovule, and found them attached with their enlarged end to the outside of the nucleus, separated from the germinal vesicle by two layers [30] of cells. It is probable that the minute, almost filiform, egg of the moth is carried with and between these bundles of pollen tubes as they elongate and push on into the ovarian cells and among the ovules.

As soon as fertilized the nascent fruit of the capsular Yuccas (and apparently also of *Clistoyucca*) becomes erect and its pedicel thickens and hardens, while the young fruit of *Sarcoyucca* remains pendulous, as the flower was, and as afterwards the mature fruit is, and its pedicel more flexible.

The Yuccas bloom from the early summer months to the end of the autumnal season. The first one in the latitude of St. Louis (all cultivated plants) is *Y. angustifolia*, which opens its flowers when the roses are in full bloom, from the middle to the end of May; the true *Y. filamentosa* makes its appearance next, about 10 or 14 days later; then come, one after another, different forms allied to the latter. Later than these, in July and August, *Y. aloifolia* unfolds its flowers, and *Y. gloriosa* very often, in our gardens as well as on the coast of South Carolina, blooms in September and even in October.

FRUIT.

The fruit of the Yucca is an oval or prismatic, more or less distinctly six-angled, more or less completely six-celled pod, usually with a short beak, bearing six rows of horizontal seeds. This pod is either pulpy and never opens, or it is dry and dehiscent, or it is intermediate between these extremes. Some of these conditions of the fruit were known to the older botanists; Linnæus (Syst. Nat. ed. X., 1759, n. 388) has a *capsula trivalvis;* Gaertner (Fruct. II. p. 34, t. 85; 1791) figures and describes the fruit of "*Y. Draconis,*" as *bacca carnosa . . . . non secedens;* Nuttall (Gen. I., p. 218; 1818), says: *capsule opening at the summit;* but he mentions that of *Y. gloriosa* as *pulpy;* Endlicher (Gen. n. 1117; 1836) tries to reconcile the apparent discrepancies by describing the capsule as *subbaccata, demum dehiscens;* Kunth, Enum., and later botanists have followed Endlicher. In the Botanical Notes to Wislizenus' Memoir of a Tour to New Mexico, etc., 1848, p. 101, I first distinguished the Yuccas with "juiceless capsules and thin seeds" from those with "succulent fruit and thick seeds." Subsequent American botanists (Torrey in Bot. Mex. Bound. p. 221, and especially Chapman in Southern Flora, p. 485), confirm and adopt these differences. In [31] S. Watson's Botany of the 40th Parallel (Utah and Nevada), 1871, I have briefly characterized the four sections of Yucca, as I now understand them.

The fruit in some Yuccas is pendulous, pulpy, and indehiscent, with a sort of crown or disc at base, consisting of the enlarged remnants of the perigonial segments and the stamens (*Sarcoyucca*); in another, thus far only imperfectly known species, the originally fleshy fruit eventually dries up, and constitutes a spongy pericarp, which never opens, and is apparently erect, with a disc at base like the former (*Clistoyucca*); in a third group, the erect fruit is dry and capsular, the base is contracted into a short obconical stipe; it opens with three valves corresponding with the carpels and dividing the primary dissepiments, the valves finally divide again at tip (*Chænoyucca*); in the fourth group, represented like the second by a single species, the pod is similar to that of the last section, but opens at tip through the middle of the carpels loculicidally, the three valves remaining entire (*Hesperoyucca*).

The secondary dissepiments are usually incomplete at base and top, and, at least in one form (*Y. filamentosa*), they are often rudimentary throughout; in *Hesperoyucca* they seem to tear irregularly at the dehiscence of the capsules.

All the Yucca fruits, but more especially the capsular ones, and those of some species more

than of others, are extremely variable in shape, and this seems to be caused principally by the irregular development of the seeds. When these fail near the middle, the capsule becomes constricted (very often in the true *Y. filamentosa*); when near the top, it usually is beaked (forms of *Y. rupicola*); so that definite diagnostic characters cannot be derived from these apparently so well-marked differences in the shape of the capsule. In the species just named, and in the *Y. baccata*, the beak of the fruit may also be the result of the development of an elongated style.

The substance and the surface of the capsules would also seem to afford good distinctions, for we find the capsule in some, thin, membranaceous, and smooth; in others, thick, ligneous, cross-wrinkled, with thick carinal and also lateral ridges, and sometimes warty; but I have observed such differences in forms of the same species, and especially in *Y. filamentosa*, which seems to be one of the most variable species, perhaps, only because we know more of it than of the others. [32]

SEEDS.

The seeds of the Yuccas are compressed, of a triangular-obovate or obliquely ovate, or sometimes even orbicular form, the straighter inner margin with the indistinct rhaphe corresponding with the secondary dissepiment, and the angle at its base containing the hilum. They vary in size from 6–12 or 13 mm. in diameter, and 0.6–3.5 mm. in thickness. The thin, black, more or less opaque testa exhibits under a strong power elevated cells or tubercles, each with or without one or several pits or impressions; in some forms these cells appear larger and irregularly rugose, but I have, thus far, not been able to discover constant specific characters even in the seed surface.

The seeds are of three different forms, corresponding with the three kinds of fruit. The baccate Yuccas have the thickest seeds (2.0–3.5 mm.), of an uneven rugose or undulating surface, with a very narrow two-edged rim, and a deeply lobed or ruminated albumen, as already indicated by Torrey, in Bot. Mex. Bound., in the instance of *Y. baccata;* I have been able to examine only the seeds of this species, *Y. aloifolia* and *Y. Treculiana*. *Clistoyucca* has a thinner seed (2 mm.), with a little more distinct rim, and with an even albumen. All the capsular Yuccas have the thinnest seeds (0.6–1.2 mm.), with a very distinct, narrower or wider, thin and brittle margin, and with an even albumen.

The semi-transparent, hard, almost corneous, farinaceous and oily albumen (ruminated in *Sarcoyucca*, plain in all the others), contains the straight or mostly more or less curved axile embryo, which extends diagonally from the hilum, to which the short caulicle points, almost to the opposite margin, thus attaining the full length of the albumen. Only very rarely and in imperfect seeds I have seen a shorter embryo, such as Gaertner figured and Kunth described, as being less than one-half or only one-fourth as long as the diameter of the albumen. The slit in the base of the cotyledon, under which the plumule is concealed, shows the cotyledon to be about four or five times as long as the caulicle.

MONSTROSITIES.

I have seen very few abnormal developments of Yuccas, and these only in the flowers. Tetramerous flowers with an eight-parted perigon, eight stamens and a four-carpellary ovary and fruit, more or less regularly developed, are not quite rare in cultivated as well as wild plants. In overgrown garden specimens of *Y. angustifolia*, I have seen flowers irregularly doubled, the number of perigonial lobes increased, some of them yet bearing the traces of anthers, or filaments bearing perfect anthers, with petaloid excrescences or wings, also filaments adnate to the ovary, and some of them even tipped with the green stigma of the species. In a cultivated form of *Y. filamentosa*, the floral axis was elongated, the perigonial segments separated and increased in number, the exterior somewhat foliaceous and bearing regular or irregular axillary flowers. [33]

GEOGRAPHICAL DISTRIBUTION.

Yucca is a peculiarly American genus, the limits of which were said by the old botanists, Linnæus among them, to extend from Canada to Peru. It is certain, however, that no Yucca grows in Canada, and I find no evidence of any being indigenous in countries south of the Equator. The greatest development of the genus is found in Northern Mexico, and the Southern United States, to the Pacific, principally between the 25th and 38th deg. N. lat. On the eastern coast, one species, *Y. filamentosa*, extends as far north as 38°, while on the western so much milder slope, they are not found farther than 35°, or perhaps 36°. On the western plains, the hardiest species, *Y. angustifolia*, reaches as high up as 44° or 45°. Southward, a form allied to *Y. aloifolia* has certainly been met with in Yucatan; and another species, *Y. Guatemalensis*, is said to be a native of Central America. I have seen no specimens from the West Indies, though many authorities credit these islands with *Y. aloifolia*, nor have I seen any from South America.

The capsular Yuccas represent the low or herbaceous northern type of the genus; all the known species belong to the United States, and only two of them (*Y. angustifolia* and *Y. rupicola*) extend beyond the Rio Grande into Northern Mexico. The baccate Yuccas are the more southern, caulescent forms, and some of the species do not come up into our territory. The eastern and western species are entirely limited by the Mississippi, which none of them seem to cross. *Y. angustifolia* is a native of the great plains from north to south, and also extends southwestwardly into the mountain region; *Y. rupicola* inhabits the southern portion of the [34] plains. *Clistoyucca* and *Hesperoyucca* are southwestern types, peculiar to Arizona and California.

SYSTEMATIC ARRANGEMENT.

In the foregoing pages it has been shown that in the fruit and seed we have excellent characters for the arrangement of the species of Yucca into several very natural groups; the nature of the edge of the leaves furnishes proper subdivisions; the specific characters are based upon the differences of trunk, leaves, flowers, and also of fruit and seed.

YUCCA, LINN.

Perigonium patulum demum globoso-campanulatum 6-partitum subpersistens; segmenta lanceolato-ovata acutiuscula; filamenta clavata multo breviora; antheræ biloculares introrsum dehiscentes parvæ; pollen globosum; ovarium tricarpellare triloculare, loculi incomplete bilocellati: stigmata 3 emarginata plus minus connata tubum stigmaticum efformantia; ovula plurima compressa horizontalia anatropa brevissime funiculata 6-seriata; fructus baccatus seu capsularis incomplete 6-locularis; semina obovato-triangularia compressa horizontalia 6-seriata nigra, embryo diagonalis albumini corneo æquilongus.

Plantæ in America tropica cis æquatorem et præcipue in boreali calidiore indigenæ; caudice arborescente elatiore vel humiliore, sæpe hypogæo; foliis in apice caudicis confertis lineari-lanceolatis crassis rigidis rarius flaccidis apice plerumque spinescentibus; panicula terminali multiflora subsessili vel in scapo bracteato elata; floribus majoribus albidis pendulis nocturnis.

I. EUYUCCA: filamenta clavata obtusa papillos apistillo plerumque breviora demum patula vel recurva; antheræ cordato-sagittatæ; ovarium prismaticum; stigmata papillosa.

A. SARCOYUCCA: fructus indehiscens baccatus pendulus; semina crassa undulata immarginata albumine lobato-ruminato. Plantæ plerumque arborescentes, panicula sæpius sessili.

* Folia margine serrulato-asperata.

1. YUCCA ALOIFOLIA, *Linn.:* caule elatiore; foliis lineari-lanceolatis supra leviter concavis nunc rigidis pungentibus lævibus margine asperrimis; bracteis paniculæ subsessilis ovatæ vel oblongæ glaberrimæ minoribus triangularibus marcescentibus; perigonii segmentis ovatis; staminibus ovarium prismaticum stigmatibus sessilibus [35] brevibus crassis rectis coronatum nunc æquantibus demum patulis; bacca prismatica 6-angulari acutiuscula.

Forma genuina: simplex vel parce ramosa ; foliis crassis rigidissimis mucrone valido brunneo pungentibus. — *Y aloifolia,* Linn. et auct. plur. *Y. Draconis?* Elliott, Bot. I. 401.

Var. β. *Draconis:* elatior, subsimplex ; foliis laxioribus sæpius demum reflexis mucrone debiliore pungentibus. — *Y. Draconis,* Linn.

Var. γ. *conspicua:* e basi ramosa ; foliis laxioribus supra lucidis in mucronem debiliorem virescentem excurrentibus. — *Y. conspicua,* Haw. Suppl. pl. succ. 32.

I have seen native flowering and fruiting specimens of the genuine plant only from South Carolina, whence Dr. Mellichamp has abundantly supplied fresh and dried material, and from Florida ; it there grows always near the coast, often and apparently most luxuriantly under the direct influence of salt water ; it extends to North Carolina and to the eastern Gulf States ; it is also credited to the West Indies and to the eastern coast of Mexico ; but on the shores of Louisiana and Texas it seems to be unknown. Var. β. is said to be a native of South Carolina ; var. γ. was described from plants cultivated in English gardens ; its native country is unknown ; my description is taken from several magnificent specimens in the botanic garden of Naples probably correctly named.

On the coast of South Carolina *Y. aloifolia* grows 6–8 or very rarely 10–12 feet high, mostly simple, sometimes in favorable localities with a few, often three, branches ; trunk seldom more than 4 or 5, at most 6 inches in diameter, only the lowest part of the oldest ones covered with a rough dark brown bark ; higher up the marks of the leaf-bases are seen, while the upper part is coated with the withered and dependent leaves themselves, persistent for years ; the rigid foliage forms dense heads, the leaves, in $\frac{1}{3}^{\frac{2}{4}}$ or even higher orders, are narrowest above the very broad base, and widest about the middle. I find them in the native specimens usually 18–24 inches long, and $1\frac{1}{4}$–2 inches wide ; grown in the shade, they reach a length of 24–32 inches by $1\frac{1}{2}$ inches in width ; under the direct influence of salt-water on the sandy beaches of the islands near Charleston they have been found shorter and broader than [36] usual (18–21 by $1\frac{1}{2}$–$2\frac{1}{2}$ inches), and it was here that the three-branched plants were observed. In cultivation the leaves are 12–21 inches long, and 1–$1\frac{1}{4}$ wide. Dr. Mellichamp has sometimes, in plants growing close to the beach, seen the upper surface of leaves incrusted with a white deposit, which might be taken for saline efflorescence, but proves to be carbonate of lime, with a very delicate film of organic matter representing a cast of the epidermis cells ; probably an exudation from these cells of oxalate of lime altered by oxidation.

The flowers open in July and August, and in the evening expand 3–4 inches, while in daytime they are $1\frac{1}{2}$–$1\frac{3}{4}$ inches deep. I find the stamens, in native as well as in cultivated plants, as long as the ovary, often as long as the whole pistil and occasionally even overtopping it. The unusually stout ovary with the short stigma is 9–11 lines long, the ovules I found 0.35–0.38 mm. thick. The pod is $2\frac{1}{2}$–3 times as long as it is thick (3–4 by $1\frac{1}{4}$–$1\frac{3}{4}$ inches), six-sided, the sides corresponding to the carpels more elevated, the alternate ones sharply depressed and turning purple before the rest of the fruit, which at last assumes a deep purple color inside and outside, has a sweet not unpleasant taste, and is much eaten under the name of Banana. It is always acutish but never rostrate, distinctly tipped with the 3-lobed stigma preserving its tube, whence the fruit is described as "perforated at the apex." The seeds, 6–7 mm. in diameter by $2\frac{1}{2}$–3 in thickness, are very similar to those of all other Sarcoyuccas examined by me.

Var. *Draconis* I cannot distinguish from the last except by the leaves being said to be less crowded, longer, softer, less pungent, and somewhat flaccid and curved. It is said to come from the same region where my specimens, above described, were obtained, and may perhaps be the form with very long leaves grown in the shade, described above. The plants, cultivated here and there under that name, may in part be *Y. Guatemalensis,* described below.

Var. *conspicua,* or at least the plant cultivated under that name in the botanic garden at Naples, differs from the type by its softer, though not pendulous, leaves, with a green scarcely pungent point. It there makes large bushes, over 20 feet high, branching abundantly from or near the base, the thickest trunks 6–9 inches in diameter. I notice that the panicles, sometimes three feet long, are almost sessile on the older trunks as they usually are in [37] this section ; but in vigorous young shoots they are borne on a scape of nearly their own length. When I examined the plants they had not borne fruit for many years, though flowering abundantly ; I learn that they have been fertile since, but have not obtained the pods.

There are other forms of serrulate Yuccas, most probably of this section, described in the books or enumerated in the catalogues of nurserymen, which are entirely unknown to me. *Y. serrulata, crenulata, arcuata, tenuifolia,* all named but scarcely described by Haworth (Suppl. Pl. succ.), about fifty-four years ago, from cultivated, partly very young plants, and not known now. *Y. aspera, Parmentieri,* and *albospica* of the catalogues, undescribed, as I believe, will probably prove in part to be forms of *Y. aloifolia,* and the names, which cannot be identified now, the original types having perhaps disappeared from the gardens and their native country being unknown, ought to be dropped. The two following, however, of which at least their flowering state and native country are known, are believed to have a claim to specific distinction.

2. Yucca Yucatana, *nov. spec.:* elata, e basi ramosissima ; foliis lanceolato-linearibus versus basin vix angustatis carnosis brevioribus margine tenuissime asperatis demum patulis recurvisve ; paniculæ ovatæ subsessilis dense

pubescentis bracteis ultimis lanceolatis albis ; florum minorum segmentis ovato-lanceolatis, staminibus demum uncinato-recurvis ovario prismatico stigmatibus parvis erectis emarginatis coronato multo brevioribus.

Ruins of Nohpat, Yucatan, collected in flower, Nov. 24, 1865, by Dr. A. Schott, who, not only by his specimens, but also by notes and sketches, aided me in drawing up this description. — Habit of the plant very similar to that of the above described var. *conspicua ;* about 20 feet high, branching abundantly from and near the base ; leaves in the specimens before me 14–16 inches long and about 1 inch wide, thick, fleshy, smooth, but apparently not rigid, with extremely slight marginal asperities ; points of leaves in my specimens broken off. Panicle densely villous, bracts fleshy, whitish; flowers spreading about 2 inches, segments 14 lines long, less than half as wide ; pistil similar to that of *Y. aloifolia,* but stamens much shorter and anthers smaller. It is quite possible that this plant is already in cultivation and may have received a name not known to me, but no accessible description agrees with it. [38]

3. Y. Guatemalensis, *Baker in Saunders' Refug. bot. V. t.* 313, *Jul.,* 1872 : elata ; foliis majoribus lanceolatis leviter concavis planiusculisve lævibus tenuioribus margine levissime asperatis mucrone concolore vix pungentibus demum patulis ; perigonii majoris segmentis lanceolatis sursum angustatis, interioribus angustioribus longioribus ; filamentis apice patentibus ovario prismatico-oblongo stylo brevissimo stigmatibusque profunde bilobis patulis coronato brevioribus.

From "Guatemala and Mexico" ; flowered in the Kew Gardens in September, 1871, whence through Mr. Baker I obtained dried specimens. That plant was 8 feet high, with leaves 2½–3 feet long, and 2½–3 inches wide ; panicle sessile between the upper leaves, ovoid, 2–3 feet long ; flowers spreading apparently 5 inches, with narrow segments (3 inches long and ¾–1 inch wide) and, an unusual case, the inner ones narrower than the outer. The most characteristic part of the flower is the ovary, which is only twice as long (¾ inch) as it is thick, and bears on a short style 3 deeply and acutely bilobed spreading stigmas ; the walls of the carpels are unusually thick, the ovules themselves have the diameter of others, but are very thick (0 5 mm.), indicating very thick seeds and a pulpy fruit, which will probably be also found short and thick.

This species is said not to be rare in collections, but seldom to flower ; it seems that it is often taken for *Y. Draconis,* and it really resembles the typical figure of that plant by Dillenius. In the botanic garden of Rome are several fine specimens named thus, which I scarcely hesitate to refer here ; they are 15–18 feet high, 1 foot in diameter at the enlarged base, not branched [6] ; leaves 2½–2¾ feet long, 2–2¼ inches wide, much contracted above their very broad base, thin and somewhat flaccid or even pendulous, glossy on the upper surface, delicately serrulate and with a very weak point. The plants have not flowered.

* * Folia margine integra.

4. Yucca gloriosa, *Linn. :* caule humiliore nunc ramoso ; foliis lineari-lanceolatis versus basin latam angustatis supra plano-concavis sæpius plicatis opacis fere glaucescentibus dorso asperulis pungentibus ; pani- [39]
cula angustiore nunc pubescente pedunculata folia excedente, bracteis e basi lata lanceolatis, summis marcescentibus ; staminibus ovarium prismaticum apice attenuatum stigmatibus gracilioribus coronatum subæquantibus, effœtis uncinatis.

Forma genuina : foliis latioribus rigidis rectis ; panicula angusta pubescente seu glabrata.

Var. β. *plicata :* foliis latioribus tenuioribus valde plicatis exterioribus patulis ; filamentis parce papillosis ovario æquilongis demum circinato-uncinatis ; stigmatibus distinctis subdivergentibus basi in stylum brevem contractis.

Var. γ. *recurvifolia:* foliis debilioribus patulis recurvis, junioribus glaucis ; panicula subpuberula ; filamentis parce papillosis pistillum æquantibus. — *Y. recurvifolia,* Salisb.

Var. δ. *planifolia:* caule brevissimo ; panicula ovata subsessili folia angustiora plana vix excedente staminibus pistillum æquantibus demum uncinatis ; stigmate brevi crasso sessili.

North Carolina to Florida on sandy sea-beaches. — All the specimens I have seen came from South Carolina, and belong to the principal form. Their stem is from a few inches to 4 or 6 feet high and 4–6 inches in diameter, simple or with a few branches, and even the oldest ones entirely covered with a shaggy coat of old withered pendant leaves. Leaves 2–2½ feet long and 1½–2½ inches wide, stiff, sharply pungent, very frequently longitudinally folded, the narrower ones sometimes even. The edge of the young leaf is pale and usually delicately serrulate toward the base ; later it turns brown and brittle, the asperities disappear, and it is apt to crumble off or occasionally to detach itself in a few fibres. The surface of the leaf is of a dull, often pale or glaucous green, and on the under side, especially towards the tip, rough with small asperities. The panicles (2–4 feet long, 1–1½ feet in diameter, contracted upward and downward, where the flowers often spring directly from the main axis) are raised above the leaves on a stalk of their own length or shorter, beset with herbaceous bracts, lanceolate from a broad base ; ultimate bracts of same shape, small and membranaceous; panicle, or at least the pedicels, often pubescent, or nearly or quite glabrous.

[6] Shoots have been cut off from the base ! These cultivated plants are often altered in appearance by trimming and by the removal of the dead leaves, which left to nature would continue to cover the trunk for several feet below the living leaves.

Flowers, as in the genus, wide open in the evening, 3½–4 inches wide, whitish, tinged externally with green or brownish or reddish green; segments ovate, acute, or nearly lance-ovate, the inner longer and wider than the [40] outer ones, minutely pubescent at tip (which, perhaps, is meant by Elliott's "sparingly ciliate"). Stamens often as long as the whole pistil, or at least as long as the ovary, straight at first or only patulous, but at last mostly recurved and even variously twisted; filaments in some forms scarcely papillose, in others strongly hispid; anthers deeply emarginate at tip; stigmas narrower than the prismatic ovary and much longer than wide, divided upwards and at last somewhat divergent; the ovules thinner than usually in this section,—in the wild flowers examined by me 0.25–0.30 mm., in cultivated ones 0.25–0.33 mm. thick. I have not been able to obtain the fruit, which is said to be 6-angled, pulpy, and of a deep purple color, by Elliott and by Nuttall, both of whom singularly enough omit to describe the much more common fruit of *Y. aloifolia*. The seed which was sent to me is smaller and thinner than that of that species (5.2–6.0 mm. in the longest diameter and 1.8–2.0 mm. thick), but otherwise very similar to it.—The flowering time seems to be July to October, very often in South Carolina in autumn.

The cultivated plants which I have seen scarcely differ from this form; their flowers are sometimes larger, and either whitish or cream-white, or very often externally greenish-purple; they seem to open usually in July and August, or sometimes later in the fall.

Y. acuminata, Sweet, and *Y. obliqua*, Haw., garden species, the native country of which is unknown, seem to belong to the typical form.

The variety which I have distinguished as var. *plicata* I have found under the name of *Y. plicata* in Mr. G. Thuret's gardens at Antibes near Nice, flowering in February and March; it has a trunk over 2 feet high, with thin but stiff much folded leaves, 1½–2¼ feet long and 2–2½ inches wide, glaucous above, rough beneath, serrulate near the base; panicle large, flowers over 4 inches wide, externally tinged with brown-red; stamens as long as the ovary, which is contracted into a narrow neck, a sort of a style, bearing the thicker, divaricate stigmas.

Var. *recurvifolia* is the well known and commonly cultivated, elegant garden form, said to come from Georgia, where Elliott also seems to have seen it, but nobody apparently has found it since. I cannot distinguish it from the type but by the flaccid, gracefully recurved leaves. *Y. recurva*, Haw., and *Y. pendula*, Sieb. and [41] Carrière, are synonymous, and *Y. superba*, Haw., *Y. rufocincta*, Haw., seem not to differ. *Y. ensifolia*, Baker, Ref. bot. V. t. 317, and the smooth-leaved *Y. Ellacombii*, Baker, Gard. Chron. l. c., Ref. bot. ib. t. 318, are intermediate forms connecting this variety with the typical plant.

Var. *planifolia* is also based on a single specimen, which I found in September, 1868, in flower in the botanic garden of Genoa, under the name of *Y. glauca*. Its short trunk, long and narrow (2½ feet long, 1½ inches wide), even, not at all plicate leaves, and especially the short stigma, which is almost as thick as the ovary and resembles that of *Y. aloifolia*, distinguish this form. Flowers whitish, smaller, 2 or 2½ inches wide; filaments as long as the pistil; anthers small, entire above; ovules only 0.26 mm. thick; fruit unknown. Could it be the *Y. glauca* of gardens?

Yucca flexilis, Carr., Rev. Hort. viii. t. 89, to which Mr. Baker refers his *Y. pruinosa*, Gard. Chron. l. c., and *Y. tortulata*, Baker, ib., may be smooth-leaved forms of *Y. gloriosa;* they are thus far only known as acaulescent, and in foliage only. Leaves of both 2–2½ feet long, 1¼ inches wide, stiff and pungent; the edges serrulate toward the narrowed base.

Yucca Boerhaavii, Baker, Gard. Ch. 1870, p. 1217: caulescens, e basi latissima lanceolato-linearibus elongatis infra vix angustatis planis lævissimis, in mucronem herbaceum mollem excurrentibus.

This plant makes a short trunk; leaves 27 inches long, about 9 lines wide, with traces of marginal denticulation; flowers are unknown.—It may be an extreme form of *Y. gloriosa*.

Yucca DeSmetiana, *Baker*, l. c.: caulescens, foliis plurimis lanceolato-linearibus brevibus versus basin angustiorem obsolete denticulatis crassis lævissimis in mucronem vix pungentem excurrentibus.

This little plant is cultivated in many gardens, but has, I believe, never flowered. The very fleshy purplish-green leaves are only 10–15 inches long, 6–9 lines wide, and scarcely pungent. Its native country is unknown.

5. Yucca Treculiana, *Carrière Rev. Hort.* vii. *p.* 280, 1858, *Baker*, *Gard. Ch.* l. c. *p.* 828: caule elato ramoso; foliis longissimis rigidissimis profunde concavo-canaliculatis margine brunneo serrulatis tunc integris demum parce filamentosis pungentibus subtus asperrimis; panicula densiflora ovata subsessili læviuscula, bracteis infe- [42] rioribus amplis ovatis seu ovato-lanceolatis pungenti-cuspidatis pergamentaceis albidis, summis ovatis seu lanceolatis albis; staminibus pistillo vix brevioribus uncinatis; ovario prismatico in stylum stigmatibus gracilibus coronatum attenuato; bacca fere cylindrica elongata rostrata.—*Y. longifolia*, Engelm. in sched. 1846; Buckley in Proc. Acad. Phil. xiv. 8, 1862.

Texas from the Matagorda Bay and the Brazos and Guadaloupe, south and southwestward into Mexico, at least as far as Saltillo, Parras, and Chihuahua, on the sea-beach and in the interior, on the gravelly overflowed banks of streams and on the stony declivities of their slopes; flowering in April and May.—Specimens from Texas and full notes were supplied by F. Lindheimer, Mexican ones by Dr. Wislizenus and Dr. Gregg.

This is perhaps the most magnificent Yucca known; trunks 6–15 and, even in Texas, sometimes 20–25 feet high, and 1–2 feet thick, terminating in several (sometimes 5–7) branches, each one bearing a crown of long rigid leaves, and often a panicle 2–4 feet long of something like 500 flowers. The bark of very old trunks has been noticed above; younger stems are covered with the reflexed withered foliage. — Leaves longer than in any other species, 2½–3 and very often 4, or even 4½ feet long and 2–3¼ inches wide when flattened out, deeply channelled and quite semi-circular in the cross-section, thick, rigid and straight, "bright sea-green," very rough on the back, less so on the upper surface, terminated by a stout brown spine. The edge of the leaf at different stages of development partakes of the character of all the three forms, as to a less extent also do the leaves of *Y. gloriosa;* the margin of the young leaf is deep brown with a pale, cartilaginous, strongly serrulate edge; then it becomes smooth and at last is often detached in brown rough fibres.

The short peduncle or scape of the inflorescence is 1–2 inches in diameter, the panicle 2–4 feet long, much branched and dense-flowered, glabrous or sometimes upwards pubescent, bearing large conspicuous bracts 4 or 5 inches long, 1–3 wide, concave, fleshy or leathery, greenish outside, whitish inside, with a sharp herbaceous or brown point; the ultimate small bracts are similar, mostly ovate-lanceolate; in Mexican specimens from Parras they are thinner, oblong, obtuse, and pure white.

The flowers vary from 2 to over 4 inches in expansion, and, if I may judge from the dried specimens, are [43] remarkable for the unusually narrow, ovate-lanceolate, acuminate segments of the perigone, 1½–2½ or even 2 inches long, and about ¼ as wide, and conspicuously pubescent at tip; in the Mexican forms I find the segments more ovate and of the ordinary shape of most Yucca flowers, and only 1¼–1½ inches long. The very slightly papillose filaments, as long as the ovary and erect in the bud, soon become recurved-hooked. The prismatic ovary terminates in a slender, short or longer style, crowned by deeply divided strongly bilobed stigmas. I find the ovules invariably thicker (0.4–0.5 mm.) than in any of the foregoing species.

The fruit is a pulpy cylindric, or rather indistinctly 6-sided, somewhat sulcate and 3-lobed, strongly rostrate berry, 3–4 inches long, about 1 inch thick, of a bitter-sweetish pleasant taste, much eaten by the Indians, who roast them and peel off the acrid rind. Seeds 6–7 mm. in the longest diameter, and 3 mm. thick, very similar to those of *Y. aloifolia*, but with the back less rounded.

Yucca canaliculata, Hooker, Bot. Mag. 86, t. 5201, 1860, described from a plant cultivated at Kew, with a stem 1–2 feet high, leaves 2 feet long, concave, semi-cylindric, rough on back, very probably is not different from our plant; the flowers, in a peduncled pyramidal panicle, 4 or 5 feet high, are described as sulphur-yellow, but are stated by Baker in Gard. Ch. l. c. to be cream-white. — A specimen in Mr. Henry Shaw's Missouri Botanical Garden, thus labelled, flowered in April, 1872; its trunk is 4 feet high, the leaves 2½–3 feet long, panicle 2 feet long, 1¼ feet wide, very densely flowered; flowers 3–3¼ inches wide, segments ovate acute, outer 8–9, inner ones 9–11 lines wide; filaments strongly recurved even when the flower has barely opened; anthers very slightly notched above, with a bunch of white articulated hair, corresponding with the hair at the tip of the perigone.

Yucca glauca, Sims, as understood by Baker and figured in Refug. bot. v. t. 315, and *Y. exigua*, Baker, ib. t. 314, which can scarcely be distinguished from it, are classed with the acaulescent entire-leaved Yuccas, though the former bears a few fibres; their fruit, in Europe unknown, may possibly be capsular, of which more at the proper place. Both are characterized by the conical attenuated stigma.

Y. orchioides, Carrière, Rev. Hort. 1861, p. 369, t. 89, as quoted by Baker, is described as the smallest of [44] all Yuccas; stemless like the last, with few short, soft-pointed leaves (9–10 inches long, 1 inch wide, almost flat); scape with a simple pubescent raceme only 1½ feet high, perianth 1 inch deep; native country unknown. — Could it be a dwarfed variety of some other form, possibly of the last-mentioned *Y. glauca?*

* * * Folia margine filifera.

6. Yucca baccata, *Torrey in Bot. Mex. Bound.* 221, 1858; *Ives's Rep. Bot.* 29: acaulis seu plerumque caulescens; foliis anguste lanceolatis versus basin dilatatam angustatis crassis rigidissimis scabris mucrone brunneo robusto pungentibus concavis; margine filis crassioribus ornatis; panicula brevius seu longius pedunculata plerumque lævi, bracteis inferioribus amplis ovato-lanceolatis cuspidatis pungentibus pergamentaceis supra albidis, ultimis lanceolatis; staminibus demum patulis vix recurvis ovarium prismaticum fere æquantibus; stylo vario nunc elongato; bacca sæpius ovata rostrata. — *Y. crassifila*, Engelm. in sched. 1848.

Forma genuina: borealis, stolonifera; caule nullo seu breviore; foliis longioribus latioribus asperrimis rigidissimis, filis marginalibus crassis cinereis; segmentis florum magnorum angustis, stylo elongato.

Var. β. *australis:* caule elato ramoso, foliis tenuioribus lævioribus, filis marginalibus tenuioribus sæpe brunneis; segmentis florum minorum ovatis, stylo breviore.

A southwestern species, extending from Southern Colorado, *C. Thomas*, to New Mexico, *Dr. Wislizenus*, *A. Fendler No.* 849, *Ch. Wright*, *Dr. Bigelow*, and West Texas, *A. Schott*, and into Southern Utah, *J. E. Johnson*, Arizona, *Dr. E. Palmer*, California (Los Angeles, *Capt. Russell*, Providence Mountain, *Dr. J. G. Cooper*, Monterey, *Dr. Parry*),

and far into Mexico (Chihuahua, *Dr. Wislizenus*, Parras, *G. Thurber*, and Saltillo, *Dr. Gregg*). — Flowering season according to latitude from March to June, or in Northern Mexico, where with the rainy season a second spring opens, often again in August and September.

The very full series of specimens before me satisfies me as to the great variability of this species, the extremes of which are so very dissimilar. The typical plant toward its northern limits is stemless, more southwardly it makes trunks of 1 or 2 to 8 or 10 feet high, covered with the refracted dead leaves. Leaves $1\frac{1}{2}$–3 feet long, 1–2 inches [45] wide, narrowed downward, gradually attenuated into a very stout, sharp or blunt brown point, channelled or quite concave, thicker than in most other species, very stiff and rough, especially on the back; on old branching plants Dr. Palmer found the leaves scarcely over a foot long and an inch wide, but very thick. The fibres are as thick as ordinary twine, and often regularly curved backward. The panicle of the stemless form is raised on a scape of almost its own length; in caulescent ones the peduncle is shorter. The exterior bracts are 4 or 5 inches long and 2 wide, similar to those of the last species, but narrower. The flowers are large, spreading 4–5 inches, segments $2\frac{1}{2}$–$3\frac{1}{4}$ inches long, $\frac{3}{8}$–1 inch wide, stamens papillose-hispid, as long as ovary, rarely at last reflexed; pistil 1–2 inches in length, style slender, unusually long for the genus, in the largest flowers equalling the ovary, in others $\frac{1}{2}$ or only $\frac{1}{4}$ its length; ovules about 0.4 mm. thick. The fruit is a dark purple berry, oval, "about the size and shape of a hen's egg," with a very distinct and often elongated beak, which is marked with six grooves, while the fruit itself is not angled or grooved. Some fruits I have seen were 3 inches long and 2 in thickness, with a beak of about half their length; one fruit from Arizona was 5 inches long, cylindric and curved. The base is protracted below the remnants of the perigon, which is not the case in the fruits of *Y. aloifolia* or *Y. Treculiana*; the pods of these three species are remarkably distinct, and always easily recognized, while the seeds themselves are very similar. The fruits are said to be "savory like dates," and are eaten fresh by whites and Indians, and cured by the latter for winter provisions. Dr. Palmer informs me that the Arizona Indians find the stewed flower-buds and flowers quite pleasant and nourishing. The seeds are often distinguished from those of the other Sarcoyuccas by their large size, 10–17 mm. in the longer diameter and 2–3 mm. in thickness; but other fruits from the same regions have seeds only 7–8 mm. long and 1.8–2 mm. thick.

Var. β., the southern or Mexican form of this species, is principally distinguished by its smaller flowers, 2–3 inches wide, with ovate or lance-ovate segments $1\frac{1}{4}$–$1\frac{3}{4}$ inches long and usually more than half as wide; by their short style and the somewhat thinner, less rough, leaves with thinner, often red-brown fibres; the panicle is sometimes pubescent. Dr. Gregg notes that it is very abundant in the plains and valleys about Saltillo; his statement is [46] almost incredible, and is not supported otherwise, that sometimes it reaches the height of fifty feet, with leaves 1–3 feet long, "seed said to be actively purgative." Prof. Thurber brought from Parras leaves and fruit of this species, an account of which, together with a cut, is found in Bartlett's Personal Narrative, II. 491: "a plain covered with Yuccas presents a beautiful appearance when in flower in pyramidal spikes several feet in length . . . . the trees 25–30 feet high and 2–3 feet in diameter, with ten or a dozen branches." He mentions that the fibres of the leaves are used for cordage, the trunks for palings or they are split into slabs for the covering of huts; the tender top of the stem is roasted and eaten under the name of *quiote;* the edible fruits are called *latiros.* A specimen of the latter I find oval, 2 inches long, with a beak of $\frac{1}{2}$ inch; seeds small for the species. We learn in the above account that the inflorescence is pyramidal; the cut represents it as sessile or peduncled, and about 3 times as long as wide.

The Californian forms are in foliage intermediate between the northern and southern extremes; a leaf collected at Monterey and distinguished by its narrowness (less than $\frac{3}{4}$ inch wide) probably indicates the northern limit of the species.

The caulescent fibrous-leaved Yuccas, recently introduced from Mexico in European establishments, of none of which either flower or fruit is known, seem distinguished by narrower and smoother leaves, some with red, others with gray marginal fibres, but they may possibly be only forms of our species; they are *Yucca periculosa*, *Y. polyphylla*, *Y. circinata*, and *Y. scabrifolia*, Baker in Gard. Ch. 1870, p. 1088, and *Y. filifera* of the gardens.

7. Yucca Schottii, *nov. spec.:* caule humiliore sæpius e basi ramoso; foliis minoribus lanceolato-linearibus rectis rigidis crassis sub-pungentibus supra concavis subtus convexis lævissimis versus basin paulo angustatis, margine filis tenuissimis rectis albidis ornato; paniculæ nunc puberulæ sparsifloræ supra folia elatæ pedunculo et ramis flexuosis, bracteis exterioribus magnis lanceolatis; florum minorum staminibus demum uncinatis, ovario in stylum brevem stigmate brevi coronatum abeunte; bacca ovata breviter rostrata, seminibus magnis crassis. — *Y. brevifolia*, Schott in Herb. *Y. puberula*, Torrey in Bot. Mex. Bound. 221, non Haw.

Upper Santa Cruz River in Southern Arizona, *A. Schott*, in June and July, 1855. — Trunk 2–5 feet high, crooked, covered with a shaggy coat of dead leaves. Leaves "yellowish-green," 9–10 inches long, 6–8 [47] lines wide; marginal fibres singularly fine and straight; panicle pubescent or glabrous, its axis not straight, as is usual in these plants, Mr. Schott expressly remarks, but variously twisted; lower bracts 4–5 inches long, 1 inch wide; the pendulous, ovate, short-rostrate berry not at all angled, about 2 inches long. — Some doubt may exist whether all the parts of specimens in Schott's, Torrey's and my own herbarium, all collected by Dr. Schott, belong

together; from these specimens the leaves and flowers have been described above, while in the account of the stem and fruit I had to rely on Mr. Schott's notes, who possibly may have mixed the fruit of *Y. baccata* with the foliage of the new plant; but the leaves appear so peculiar that there can scarcely be a doubt about the distinctness of the species to which they belong.

B. CLISTOYUCCA: fructus indehiscens, erectus? demum siccatus, spongiosus; semina crassiuscula plana vix marginata, albumine integro. — Arbor elatior ramosa, panicula sessili.

* Folia serrulato-asperata.

8. YUCCA BREVIFOLIA, *Engelm. in S. Watson, Bot. King Expl.* 1871, *p.* 496: caule elato ramoso; foliis brevibus e basi lata sensim angustatis late linearibus supra planiusculis versus apicem concavis subtus convexis carinatis pungentibus rigidissimis utrumque asperrimis margine durissimo serrulatis; panicula sessili ramosa; fructu ovato obsolete 6-angulato acutato. — *Y. Draconis?* var. *arborescens*, Torr. Bot. Whipp. Pac. R. Exp. iv. 147.

On the arid plateaus between the Colorado River and the South California Mountains, in latitude 34½°–36°, at an altitude of 2000–4000 feet, in patches from Southwestern Utah, Northwestern Arizona to Southern Nevada and to Southeastern California, where it is abundantly distributed on the "Palm-plains," also called "Tehachipi desert," between the Mohave River and Walker's Pass, often forming straggling forests. It was first noticed by Fremont, 1844, ten years later by Bigelow, and since then by Brewer, Parry, Palmer, and Johnson, and has lately even formed the object of photographic pictures. Leaves and fruit with seeds have been obtained, and young plants raised, but the flower remains unknown.

This remarkable Yucca makes considerable trees, 15–20–30 feet high; the stout rough-barked trunks, [48] often 1–2 feet in diameter, 3–10 feet high, before they send off the long and numerous branches, of which, in a very characteristic photograph, I have counted 23 large and small ones. Leaves stiffer, harder and rougher, and perhaps shorter than in any other species, sometimes only 3–4, usually 6–8, and rarely, in young and vigorous specimens, even 10–12 inches long, 3–6 lines wide, not at all narrowed above the base, glaucous, very rough on both sides, with small but stout whitish or brown teeth on the edge, and a stout and sharp brown point. The flower is said to be small and white. A fruit before me is evidently erect, as the fragment of the branch to which it is attached indicates, oval, slightly 6-sided, pointed but not rostrate, and tipped with the well-preserved short, sessile stigmas. The fruit is light and perfectly dry, the brown somewhat spongy fragile pericarp 2–3 lines in thickness. Seeds large, 11–12 mm. in diameter, 2–2½ mm. thick, with a narrow margin and an even, not ruminated, albumen. In both the fruits I have been able to examine, the traces of the moth *Pronuba* are apparent by the perforated rind and gnawed seeds or their empty ring-like rims.

C. CHÆNOYUCCA: fructus capsularis, erectus, septicide dehiscens, demum apice 6-valvis; semina tenuia plana, latius marginata, albumine integro. — Acaules vel vix caulescentes, panicula in scapo elata.

* Folia margine serrulato-asperata.

9. YUCCA RUPICOLA, *Scheele in Linnæa*, 23, *p.* 143, 1850: acaulis, foliis lineari-lanceolatis supra basin latiorem angustatis canaliculatis supra planiusculis subtus convexis rigidis erectis pungentibus; scapo elato infra bracteis majoribus foliaceis ornato, panicula pyramidali laxiflora bracteis parvis marcescentibus stipata; florum majorum segmentis ovatis acuminatis nunc aristatis apice sub-nudis, staminibus rectis demum patulis ovario ipso æquilongis, stylo elongato; capsula acuta seu rostrata nunc medio constricta; seminibus angustius marginatis. — *Y. tortifolia*, Lindheimer in sched. 1846, *Y. lutescens*, Carrière, l. c. vii. 579, ex Baker.

Var. *α. tortifolia:* foliis saturate viridibus varie tortis undulatisve sæpius obliquis dorso lævibus et capsulis cum seminibus majoribus.

Var. *β. rigida:* foliis pallidis glaucis planis dorso carinatis asperatis et capsulis cum seminibus minoribus. [49]

Western Texas, in fertile soil mixed with broken-up cretaceous limestone rocks, discovered by F. Lindheimer, 1845, on the plateaus west of New Braunfels, and described from his specimens by Scheele; found afterwards by the botanists of the Mexican Boundary Survey; the second or southwestern form was sent by Dr. Gregg from Mapimi in the Mexican State of Coahuila, and by Dr. Bigelow from the mountains of the volcanic district of Bufatello near Presidio del Norte on the Rio Grande. — Flowers in Texas in May and June, "after *Y. Treculiana* and before *Y. angustifolia*."

As far as my information goes this species is always stemless; a misapprehension of Lindheimer's notes must be the cause of Scheele's, and after him Baker's, ranging it among the caulescent Yuccas, with a "stem 4–7 feet high;" rootstock of few stout branches 1–2 feet long; leaves dark or bright green, opaque, narrowed above a not very broad base 1–2 feet long, ¾–1¾ inches wide, with brown-red, strong serratures, mostly undulate, oblique, one side longer than the other, therefore twisted, stout, thick, sharp-pointed, but not to be compared with *Y. aloifolia*. Scape 4–7 feet high, with long leafy narrow lanceolate bracts; panicle with few large "greenish-white" flowers, which apparently spread 3–4½, perhaps 5 inches, and are well characterized by the very acute, sometimes even aristate when dried,

strongly nerved segments, 1½–3¼ inches long, 10-14 lines wide, the inner wider than the outer; also by the erect or slightly spreading, never recurved stamens, which are of the length of the prismatic ovary; and by the slender style, which in all the specimens seen by me is as long as the ovary; ovules 0.2 mm. thick. Capsule 2–2½ inches long, about an inch thick, acute or cuspidate or rostrate, prismatic, or very often variously constricted or distorted, often showing traces of the Yucca moth; secondary dissepiments sometimes, like those of most species, incomplete at top and bottom, but not rarely, especially in very acute capsules, entire above or nearly so. Seeds 7–8 mm. long, with a distinct but narrow margin. — This form is reported to be in cultivation in France from Mr. Trecul's seeds, under the name of *Y. tortilis* or *contorta*.

Var. *rigida* looks very different indeed, with its smaller, pale, yellowish or glaucous, often rough, straight leaves, only 8–12 inches long, and 3–6 lines wide, and its small wrinkled, less pointed capsule, 1½ inches in [50] length, and seeds only 5–6 mm. in diameter; the scape is said by Dr. Gregg to be 5–10 feet high; flowers not seen; the short beak of the fruit indicates a short style. Wright's No. 1909 from Eastern New Mexico connects both forms.

* * Folia margine filifera.

10. Yucca angustifolia, *Pursh. Fl.* ii. 227: subcaulescens; foliis (plurimis) e basi latiore linearibus lævibus plerumque pungentibus; stigmatibus ovario brevioribus viridibus; capsula prismatico-ovata obtusa brevi-cuspidata, seminibus magnis late marginatis.

Forma genuina: acaulis seu breviter caulescens; foliis rigidis radiatim porrectis pungentibus; racemis plerumque simplicibus inter folia fere sessilibus; florum segmentis late ovatis e cupreo virescentibus nunc albidis; capsulis majoribus vix unquam constrictis.

Var. β. *elata:* caule altiore; foliis numerosissimis rigidis pungentibus nunc glaucescentibus filamentosissimis rare denudatis, demum refractis; panicula oblonga seu lanceolata supra folia elata; florum segmentis albidis angustioribus; capsulis ut supra. — *Y. angustifolia var. radiosa*, Eng. in King Bot. 40th par. 496.

Var. γ. *mollis:* acaulis; foliis supra basin angustatis medio latioribus mollibus vix pungentibus; racemis rarius ramosis scapo ipso bracteis brevibus lanceolato-subulatis ornato brevioribus; capsula breviori nunc cum seminibus angustius marginatis minore. — *Yucca stricta*, Sims Bot. Mag. 2222 fide Baker, Gard. Chron. l. c.

All the forms of this species are characterized by the secondary axis descending horizontally, narrow leaves, bright green stigmas, and large capsules and seeds; but var. γ. in many respects approaches to and forms a connecting link with the next species. They are peculiar to the West and Southwest.

The typical *Y. angustifolia* is the more northern form of the plains from Northwestern Missouri and Western Iowa west and northwestward to Colorado and New Mexico; flowers May and June, earlier than the allied species. Trunk none, or, farther south, short; leaves very stiff and sharp-pointed, 1–2 or in cultivation 3 feet long, 3–6 lines wide; raceme simple or with few short branches 1 or 2 to 3 or 4 feet long almost sessile, the base hidden between the inner leaves; flowers 1½–2½, in cultivation even 4 or 5 inches wide, usually greenish white or [51] tinged with green-brown; lobes broadly ovate; stigma half the length of ovary; capsule usually 3 inches long, half as thick; seeds 10–12 mm. wide. In dwarf forms the leaves are sometimes only half a foot long and 1–2 lines wide.

Var. β. is the southwestern form extending from West Texas to Utah, Arizona, and Northern Mexico; trunk 3–5 feet high; leaves ¾–1½ feet long, 3–6 lines wide, rigid, often glaucous, with an abundance of long fibres or, rarely, almost destitute of them (Wright, Gregg); naked part of scape about as long as the panicle, together 6–8 feet, whole plant therefore often over 12 feet high; flowers mostly white, 2–2½ inches wide; capsules and seeds as large as in the type. It is not improbable that the narrow-leaved Mexican forms, doubtfully referred to p. 46, *Y. baccata*, may belong here; flower and fruit would decide.

Var. γ. is found southeastward in Arkansas, Louisiana, and throughout Texas, distinguished by its wider, softer, less pungent leaves, distinctly narrowed above the base, 1–1½, rarely 2 feet long, 5–8 lines wide in the middle, half as wide below; scape 2–3 feet high, flowers usually in a raceme, ½–1 feet in length, sometimes paniculate, 1½–2½ inches wide, greenish-white; green stigmas sometimes as long as ovary, often shorter; capsule shorter than in the other forms, 2–2¼ inches long, sometimes constricted; seeds 9–10 rarely 10–12 mm. wide. *Y. stricta*, which is referred here, is said to come from South Carolina, entirely outside of the limits of this form, which makes a transition to the next.

11. Yucca filamentosa, *Linn.:* subacaulis; foliis lineari-lanceolatis supra basin latiorem contractis apice indurato seu molli; panicula pyramidata in scapo foliaceo-bracteato alte supra folia elata; stigmatibus elongatis nunc distinctis albidis; capsula cuspidata, seminibus angustius marginatis.

Forma genuina: sæpius breviter caulescens; foliis rigidioribus rectis mucrone nunc obtusato brevi apicatis dorso scabridis, filis marginalibus crebris plerumque circinatis; panicula ramis fere horizontalibus pyramidata densiflora scapo bracteis minoribus spatulatis instructo æquilonga seu longiore lævi; staminibus sæpe pistillo æquilongis; stigmatibus gracilibus demum divergentibus seu recurvatis; capsula minore plerumque medio constricta, dissepimentis secundariis fere semper rudimentariis; seminibus minoribus.

a. angustifolia: foliis (plurimis) lineari-lanceolatis e medio sensim angustatis. — *Y. filamentosa*, Linn. ex Gronov. virg. 152.

b. latifolia: foliis (paucioribus) rigidioribus sursum latioribus nunc spathulatis versus apicem sæpius obtusatum abrupte mucronatum cochleato-concavis. — *Y. concava*, Haw. suppl. 34. [52]

Var. *β. flaccida:* acaulis; foliis (pluribus) lineari-lanceolatis mollibus flaccidis demum irregulariter decurvatis refractisve glaucescentibus vix scabrellis subinermibus margine filis tenuissimis abunde ornatis; scapo bracteis brevibus spatulatis instructo paniculæ nunc puberulæ æquilongo; ovario versus basin irregulariter angulatam angustato, stigmatibus brevioribus conniventibus sursum attenuatis; capsula majore sæpius constricta angulata sursum profunde triloba, seminibus majoribus. — *Y. flaccida*, Haw. suppl. 34? Refug. bot. 5, t. 323?

Var.? *γ. bracteata:* subacaulis; foliis (plurimis) lineari-lanceolatis rigidiusculis scabrellis mucrone debili aristatis abunde filiferis, exterioribus demum nudatis laxis; scapo bracteis foliaceis majoribus infra medium latioribus sensim angustatis fere imbricato flexuoso quam panicula ramis ascendentibus pyramidata asperula seu puberula multo longiore; staminibus ovarium fere æquantibus; stigmatibus profunde divisis elongatis; capsula prismatica ovatave.

Var. ? *δ. lævigata:* subacaulis; foliis (paucioribus) lanceolato-linearibus elongatis fere planis lævibus rigide pungentibus margine mox denudatis laxis deflexis demum decumbentibus; scapo bracteis lanciformibus e medio sensim angustatis instructo quam panicula ramis ascendentibus laxifloris pyramidata lævissima multo longiore; ovario staminibus breviore stigmatibus ad basin divisis rectis æquilongo; capsula prismatica.

This most variable plant is a native of the coast region of the southeastern States from Maryland, *W. M. Canby*, to Florida, Alabama, and, according to Riddell's Cat., to Louisiana. — Numerous varieties, often difficult to class, have been described in European gardens.

Linnæus' diagnosis: *foliis lanceolatis acuminatis*, together with the Hab. Virginia, points to the narrow-leaved form of what I have described as the genuine plant, as the one he and Gronovius had in view. Of this and other forms numerous specimens and full notes have been obtained from Dr. Mellichamp, of South Carolina, on which the following descriptions are based.

The genuine plant has a short trunk of 2–5 inches or a foot (Chapm. Fl. 475), stiffer, rougher, "reed-like," dull green leaves and smaller capsules than any other variety, and blooms earlier, in S. Carolina in May, in gardens of St. Louis in the first weeks of June. — The narrow-leaved form makes tufts of 60–80 or 100 leaves, 16 or 18–20 and 22 inches long, 1–1¼ rarely 1½ inches wide, widest about the middle, tapering to a hard obtusish point, with numerous rather thin curly fibres. The broad-leaved variety has only 30–60 leaves, 20–24 inches long, 2–3 inches wide about the upper third, and broad to the almost obtuse blunt tip; outer shorter leaves often broad-spatulate and quite obtuse; margin with fewer, coarser, more curly threads. The scape of both forms is 4–8 or 9 feet high, stout, very soft and smooth, pale green, below with oblique, spatulate bracts, 2, rarely 3 inches long; panicle with numerous nearly horizontal dense-flowered branches as long or longer than the naked part of the scape. Flowers 2½–3 inches wide, white, tinged with green; stamens as long as the pistil, at last spreading, the elongated eventually recurved stigmas rather shorter than the ovary. Capsule 1½ inches long, more or less constricted, thin, smooth, and papery in some localities, hard, wrinkled, and longer beaked in others; secondary dissepiments mostly very incomplete, not reaching to the centre, but in a Maryland specimen, and in some cultivated ones, of the ordinary form, so that no specific character can be based on them; seeds 6 mm. diam. — Forms intermediate between *a.* and *b.* are found wild and in cultivation; leaves sometimes more flaccid, with fewer fibres, shorter stamens or stigmas, longer capsules, larger seeds. [53]

The variety *flaccida* is described from plants in common cultivation about St. Louis; wild specimens I have not seen. It is doubtful whether it is Haworth's plant, which has *fila validissima*, or of the *Refugium*, with broad, involute leaves, but the short attenuated stigmas fully agree; the characters indicated in Gard. Chron. l. c., "an irregular, untidy appearance," "leaves conspicuously filiferous," "point not at all pungent," "panicle pubescent," point to our plant. — It is mostly stemless with 40–60 leaves, 20–26 inches long, 1–1¼ inches wide, thin, at first glaucous, flat, sometimes plaited, with a weak not pungent point, and numerous very thin threads, outer ones abruptly recurved or deflexed. Scape 4–6 feet high, bracts as in the last; panicle pubescent, about as long as the naked part of the scape. Flowers 2–3 inches wide, white with greenish; ovary attenuated and angular-impressed toward the base and attenuated upwards toward the short, somewhat unequal, together conical stigmas. Capsule 2½ inches long, always constricted in the middle, angular and towards the short beak deeply trilobed; seeds 8–10 mm. long. — *Y. puberula*, Haw. Phil. Mag. 1828, p. 186, Refug. l. c. t. 322 is scarcely distinct, as Mr. Baker l. c. already suggests for this as well as for *Y. flaccida*. — *Y. glauca*, Sims Bot. Mag. t. 2662, Refug. t. 315, with exactly the pistil of our plant, but leaves almost without fibres, also belongs here.

The two following forms, which may eventually prove distinct from *Y. filamentosa*, I have not been able to identify with any described species. All often grow together on the coast of South Carolina and there ever retain their characters unaltered.

Var. ? *bracteata* has 50–100, usually about 70 leaves 20–24 inches long, 1–1¼ or even 1½ inches wide, with a sharp

but slender and weak point, and numerous thin deciduous threads. Scape 4–6 feet high, stout, greenish bronze, almost covered with large foliaceous bracts, the lower 9–12, upper 4–6 inches long, tapering upwards; panicle contracted, scarcely half as long as the flowerless part of the scape, rough, uneven, or somewhat pubescent. Flowers white with greenish, about 3 inches wide; pistil 16 lines, stamens half as long, elongated stigmas at last divaricate at tip. Capsule 1½–2 inches long with a short cusp, rarely constricted. Seeds 8 mm. wide. The rarest of the South Carolina forms, and not seen from anywhere else; flowers later than the others, in the second half of June.

Var.? *lævigata* is well characterized by its very long (30–40 inches, 10–15 lines wide), deep green, smooth, [54] thickish, very sharp pointed leaves, only 25–50 in number; lower third attenuated into a narrow stalk, leaf therefore soon decumbent; epidermis cells 3 times as long as wide. Scape 8–10 feet high, smooth, purple below with lance-shaped bracts 6–9 inches long; panicle half as long as peduncular portion, contracted, with comparatively few, sometimes slightly pubescent branches. Flowers often in pairs, smaller than in last, 2½–3 inches wide, white with purple tinge, of a strong almost disagreeable odor, which was not noticed in other varieties; stigmas divided to the base, deeply bilobed. Capsules 1½–2 inches long; short pointed; seeds 8½–9 mm. wide. This is the most common species between Charleston and Hilton Head, on the sandy coast, but is also found on the clayey soil up the rivers; it probably extends down the coast to Florida, as I have seen a specimen from Tampa Bay, — flowers about 2 weeks after the first and as long before the last form. A transition form between this and the regular *Y. filamentosa* is cultivated in the Missouri Botanical Garden, with shorter, weaker-pointed leaves, lanciform bracts, and constricted capsules.

II. Hesperoyucca: filamenta clavata, acuta, lævia, erecta, pistillo sublongiora; antheræ didymæ transversæ; stylus tenuis; stigma calystræforme papilloso-pilosum; capsula erecta loculicide trivalvis, valvis indivisis; semina ut in *Chænoyucca*. — Planta acaulescens, folia margine serrulato-asperata, panicula in scapo elata.

12. Yucca Whipplei, *Torrey, Bot. Mex. Bound.* 222; *Bot. Exp. Ives*, 29: subacaulis; foliis paucioribus e basi lata attenuatis lineari-subulatis sæpe falcatis carinatis rigidis pungentibus lævibus glaucis; scapo bracteis late vaginantibus sursum foliaceis pungentibus munito paniculam grandi-bracteatam lævem gerente; capsula globoso-obovata obtusa.

California, on dry rocky hills, rare north of San Francisco, abundant from Monterey to San Diego, eastward to the Cajon Pass and into Northwestern Arizona; flowers in April. — Trunk none or short, sometimes prostrate between rocks, stoloniferous; leaves 10–20 inches long, 4–6 lines wide, concave only near the stout point; scape 4–12 feet high, together with the lower part of the panicle itself, beset with bracts 6–9 inches long, consisting of a broad whitish base terminating in a short rigid leaf. Flowers greenish white, spreading 2 to 4 inches; segments 1½–2½ inches long, 5–12 lines wide, outer much narrower than inner ones; anthers 1–1½ lines across; pistil 4–8 lines long; style proper slender, as long as or much shorter than the ovary; trilobed hood-like stigma 3 times as thick as style and longer than thick. Capsule less than 1 to nearly 2 inches long, frequently rough; secondary dissepiments incomplete at both ends, divided and often rent by the opening of the capsule; seeds 6½–8 or 9 mm. in diameter, with a very narrow margin. — Most of the specimens and numerous notes have been communicated by Prof. W. H. Brewer of the California State Survey.

CORRECTIONS AND ADDITIONS. [55]

Page 24, line 33. Mr. Baker gives 150–180 as the number of leaves of *Y. recurvifolia*.

" 26, " 5. They are *always* thus tipped, much more sparingly in some species than in others; hair usually 1-celled, sometimes articulated.

" 27, " 20. The ovules of *Y. Treculiana* are among the thickest of any.

" 29, " 8. I have found the pods of *Y. aloifolia, Treculiana, baccata*, and *brevifolia* perforated and the seeds eaten by the larvæ.

" 33, " 23. They reach nearly to the same northern latitude.

" 42, " 22. Leaves of young plants nearly flat, whence discrepancies in descriptions.

" 46, " 2. Dr. Wislizenus ascribes them the same height.

" " 26. They rather belong to or near *Y. angustifolia;* only the fruit will decide.

Yucca spinosa, HBK. N. Gen. I. 289, is made up of the flower of a Yucca and the leaves of *Dasylirion acotriche*. (See p. 24, note.)

Yucca acaulis, HBK. ib., is a *Fourcroya*.

Yucca? parviflora, Torr. Bot. Mex. Bound. 221, constitutes the genus *Hesperaloe*, Engelm. in King Bot. 40th Par. 497.

ADDITION TO ARTICLE ON YUCCA.

[l. c. 1876, III. pp. 371, 372.]

Page 47. *Y. brevifolia* has sessile, densely-flowered panicles; flowers greenish-white, inconspicuous, and fetid. Flowers in April and May. — It is remarkable that at least in Southeastern Nevada [372], north of the great bend of the Colorado River, where Messrs. Johnson and Parry have repeatedly examined numerous plants, no fruit has ever been found.

Page 54. *Y. Whipplei* has now become quite familiar through living specimens and beautiful photographs. From the latter we learn that the scape is imbricately covered with conspicuous, broad, at last patulous or drooping bracts, and that the panicle is densely flowered, narrow, spike-like, almost lanceolate.

III. NOTES ON THE GENUS YUCCA. NO. 2.

[l. c. pp. 210–214.]

Since my paper on Yucca was published (pp. 17–54 of this volume) I have been ena- [210]
bled to make the following corrections and additions: —

Page 20. The examination of more seedling Yuccas has proved that the growth of the secondary axis and the young rootstock exhibits the following forms: In *Y. aloifolia* as well as in *Y. filamentosa*, var. *lævigata*, I have found a single horizontal branch; in *Y. angustifolia genuina* and var. *elata*, a single perpendicular branch directed downward, and in *Y. filamentosa genuina latifolia* all the young plants examined at the end of the second year exhibited 2 to 5 secondary axes directed downwards ½ to 2 inches and then abruptly bent upwards. More observations are needed about these interesting peculiarities and their constancy in each species or variety; it is possible that the nature of the soil and the mode of cultivation may have some influence on them.

Page 26. The bunch of white wool is always present at the tip of the perigonial lobes, but is very slight and short in some, and longer and more copious in other species; the hairs constituting it consist of single or sometimes of several cells.

Page 27. *Yucca Treculiana* has, as is also stated on p. 43, very thick ovules, and thus *all* Sarcoyuccas have such ovules and can by them be readily recognized even in the flower and where the fruit remains unknown. *Y. gloriosa* with its thin ovules does not belong to this section at all, as will be shown below.

Page 28. The stigmatic tube does communicate directly with the three ovarian cells, but the passage closes immediately after the night of flowering.

Page 29. I have seen the vestiges of the moth, or rather its larva, in all the Sarcoyuccas as well as in all [211]
those with dry pods; but fruits which show no trace of the larva may be seen more frequently in the former than among the latter. This does not indicate that all may not have been fertilized by the action of the moth, but in such cases either no eggs were laid or they may have aborted.

Observations made last year by Mr. Riley and myself have proved that the filiform flexible egg of the moth is not deposited with the pollen into the stigmatic tube, but that the mother introduces it through a puncture in the side of the ovary directly into one of the cells just between two ovules, both of which at once begin to swell up to three or four times the thickness of the healthy ovules, and are thus preparing the sustenance of the young larva, which feeds on one or usually on both of them until able to attack the meanwhile more or less developed young seeds joining the former. In a few cases I have seen the very young larva at a place where four ovules, two from each side, meet, and here all four were prematurely enlarged.

Page 31. See below an account of the fruit of the *Clistoyucca*.

Page 34. At the end of the character of *Yucca* add: floribus majoribus pendulis nocturnis albidis nunc virescenti seu purpurascenti colore tinctis olentibus.

Page 36. Southerners object to the remark, that the fruit of *Y. aloifolia* is "much eaten;" I should say that it is edible. I am informed that on the coast of Florida this species makes almost impenetrable thickets, in which bears have their passages and no doubt their lairs, and in the fruit of which they delight.

Page 37. *Y. aspera* and *Y. albospica* are erroneously introduced here; for their proper place see below.

Page 38. *Y. gloriosa* does not belong to *Sarcoyucca*, where, relying too much on the statements of others, I had placed it. Dr. A. Schott, who has repeatedly been mentioned by me as a close observer of Yuccas in the Southwest,

was fortunate enough last autumn to discover a specimen loaded with fruit, growing in the open ground in the Congressional garden at Washington. A photographic view was taken and specimens of the fruit and ripe seed [212] were gathered, which latter have already germinated. The fruit is a pendulous, dry, leathery, not-opening capsule or berry, of deep brown color, with (as the ovules, described p. 40, indicated) thin seeds; the species therefore belongs to *Clistoyucca*, the character of which section will have to be slightly modified. Those botanists who described the fruit as pulpy must have confounded it with that of *Y. aloifolia*, as indeed seedsmen in Europe also have done, whose wrongly-named seeds, raised in Italy or Sicily, I have on page 40 erroneously described as those of *Y. gloriosa*.

The best formed fruits seen by me were, before full maturity, 3 inches long, 1 inch in diameter, prismatic, cuspidate, the 3 wider sides forming the back of the carpels and opposite the outer segments of the flower, and 3 alternate sides, corresponding to the commissures, only half as wide as the others, depressed and separated from the others by 6 prominent ridges. The fruit at this stage is altogether like a small fruit of the *Y. aloifolia*, only more pointed. At maturity its parenchyma dries up, the texture becomes leathery, and the markings less distinct. Fruits infested by larvæ are often smaller, constricted about the middle or variously twisted. In such fruits the rains of a wet autumn are apt to penetrate through openings made by the larvæ, and cause the germination of the seeds in the closed pod. — Seeds 7–8 mm. in the longest diameter, 1–1¼ mm. thick, with an entire albumen; differing from the seeds of the capsular Yuccas only by the entire absence of a wing-margin.

Page 41. *Y. Treculiana* and *Y. canaliculata* are synonymous. If, as it is said, no sufficient character accompanies the name given by Carrière in 1858, and if the first description of *Y. Treculiana* was published by Herincq, 1863, in the *Horticulteur Français*, then Hooker's name of *Y. canaliculata*, published with description and figure in 1860, would have precedence. — Fruits lately obtained from Southwestern Texas are 3–4½ inches long and 1–1¼ in diameter, pointed but scarcely rostrate, somewhat less distinctly six-angled than those of *Y. aloifolia*. Seeds 7–8 mm. wide, 2–3 mm. thick, the smallest ones the thickest. — *Yucca aspera*, Regel, Gartenfl., is the same, to judge from a specimen cultivated here; *Y. gigantea*, Lem. Rev. Hort. 9 (1860), p. 222, fide Baker Gard. Chron. l. c., [213] would, from the size of the leaves (4½ feet long), have to be referred here, if the leaves were not said to be glabrous and shining.

Page 47. The character of *Clistoyucca* is to be modified as follows: —

Fructus indehiscens, pendulus (in altera specie erectus?), demum siccatus; semina tenuiora, plana, vix marginata, albumine integro. — Plantæ caulescentes, altera arborescens, panicula sessili vel pedunculata.

* Folia serrulato-asperata.

Yucca brevifolia, *Engelm.:* pericarp spongy (erect?), seeds thicker. — Dr. Parry has just sent a specimen, which shows the panicle to be ovate, dense-flowered; bracts wide and membranaceous, much like those of *Y. Treculiana* (as are also the flowers), the lower ones 2 inches wide, 3–4 inches long, tapering into a herbaceous serrulate point; the upper ones 1 inch long, oblong obtuse, of thinner texture, white; segments of perigone 2¼–2½ inches long, narrow; ovary attenuated into a short style, ovules 0.4 mm. thick. — In Southern Utah in flower about the end of April.

* * Folia margine integra, etc.

Yucca gloriosa, *Linn.:* pericarp leathery, pendulous; seeds thinner.

Page 50. *Y. constricta*, Buckley, Proc. Phil. Ac., 1862, page 8, seems to belong to *Y. angustifolia*, var. *elata*, and *Y. albospica* of European gardens to var. *mollis* of the same.

Page 51. *Y. filamentosa*. Numerous specimens from South Carolina, Georgia, and Alabama, prove that the varieties are difficult to keep apart. Even the most marked forms of *genuina latifolia* have sometimes large, not contracted, capsules, with nearly complete secondary dissepiments and large seeds. As thus the characters by which I have tried to distinguish the *forma genuina* prove to be uncertain, this arrangement of the different forms will have to be abandoned; we may simply distinguish them as var. *angusta* (preferable to *angustifolia* on account of the species of that name), var. *lata*, etc. *Y. filamentosa* seems confined to the low country of the Southeastern States and not to penetrate into the interior more than perhaps 100 miles, while *Y. gloriosa* and *Y. aloifolia* appear to be strictly seaside plants. The westernmost specimens of *Y. filamentosa* I have seen came from the western border of [214] Alabama; but it is said to grow also in Mississippi and Louisiana.

Var. *flaccida:* the contracted panicle is usually shorter than the peduncular part of the scape.

Var. *lævigata* I have now also seen in cultivation, remarkable for the narrow, smooth, flaccid or even prostrate leaves; the tall (6–9 feet high) scape purplish-brown; the narrow panicle three times as long as wide, about as long as the peduncular part of the scape; flowers and young fruit with purplish tinge; secondary dissepiments of large capsule very incomplete, or almost wanting; in the wild plant they are nearly perfect.

Page 54. *Y. Whipplei* does not occur north of Monterey; it abounds near San Luis Obispo, whence Dr. W. W. Hays has sent seeds and living plants.

The following synopsis exhibits at a glance the arrangement of the species and their geographical distribution:—

YUCCA, LINN.

SARCOYUCCA.

1. *Y. aloifolia*, Linn., southeast and south.
2. *Y. Yucatana*, Eng., south.
3. *Y. Guatemalensis*, Baker, south.
4. *Y. Treculiana*, Carr., southwest.
5. *Y. baccata*, Torr., southwest.
6. *Y. Schottii*, Eng., southwest.

CLISTOYUCCA.

7. *Y. brevifolia*, Eng., southwest.
8. *Y. gloriosa*, Linn., southeast.

CHÆNOYUCCA.

9. *Y. rupicola*, Scheele, southwest.
10. *Y. angustifolia*, Pursh, west and southwest.
11. *Y. filamentosa*, Linn., southeast.

HESPEROYUCCA.

12. *Y. Whipplei*, Torr., southwest.

IV. SCATTERED DESCRIPTIONS OF YUCCA.

FROM BOTANICAL GAZETTE, 1881, VI. 224.

YUCCA MACROCARPA. n. sp. Trunk several (1–4) feet high; leaves spreading, sharp-pointed, concave with entire margins; panicle subsessile with lanceolate white fleshy bracts; flowers not seen; fruits cylindrical not marked by any ridges, obtuse, pale yellowish, pulpy (4–6 inches long, 6–7 in circumference); seeds thick and large (5–6 lines wide, 1–1¼ lines thick), rugose-ruminated.

In ravines of the Santa Rita Mountains south of Tucson, Arizona. — Evidently closely allied to *Y. baccata*, Torr., which is found from Southern Colorado all along through Arizona to Southern California; distinguished from it by the absence of fibres on the leaf-edges (I have rarely seen on one or the other thin fibre detached from the edge, just as we find it sometimes in *Yucca gloriosa*, and *Y. canaliculata*, which ordinarily have entire edges), by the smaller, narrow bracts, and the obtuse, not rostrate fruit. The fruit is of the color of a yellow apple, rather pulpy, of a pleasant sweetish acidulous taste.

FROM BOTANICAL GAZETTE, 1882, VII. 17.

YUCCA ELATA. Trunk 3 to 5 feet or more high, leaves linear rigid sharp-pointed, filamentose on the white margins; with white oval acute or acuminate bracts as long as the pedicels; flowers white; segments ovate acute; ovary attenuated into a whitish style; capsule cylindrical-ovate obtuse short-cuspidate; seeds large, ½ inch wide, narrowly wing-margined. — *Y. angustifolia*, var. *elata*, Engelm., Notes on Yucca, p. 50. *Y. constricta*, Baker, Yuccoideæ, p. 229; not Buckley.

Deserts of Arizona, probably extending into Southern New Mexico and Mexico. Altogether one of the most stately Yuccas, distinguished from the closely allied *Y. angustifolia*, with which I had formerly united it, by its distinct trunk, which is usually 3 to 5 feet, but which I have seen even 10 or 11 feet high, and 3 to 7 inches thick, and especially by its long flowering scape, 3 to 7 feet, naked below, and bearing a much branched panicle often 5 feet long; flowers spreading, 3½ to 4 inches wide, while those of the allied species are more globose, mostly of a greenish color, with broadly oval concave segments, with a green stigma; capsule similar to that of *angustifolia*, seeds of same size as in that species but with a narrower margin. Young specimens flower before they make a trunk, and they look much like *Y. angustifolia*, but can always be distinguished by the naked scape and by the characters of the flower.

Yucca constricta, Buckley, appears to be a form of *Y. angustifolia* with a short trunk; the constricted capsules ascribed to it are not normal, but occasionally occur in all species of Yucca.

YUCCA MACROCARPA, Engelm., VI. 224, of this Journal, has now been found by C. G. Pringle in flower; the panicle is densely pubescent; flowers about $2\frac{1}{2}$ to $3\frac{1}{2}$ inches wide with broadly oval acutish segments. *Y. baccata* has a glabrous panicle and larger flowers with narrow tapering segments. *Y. Schottii*, Engelm., Yucc. 46, from Arizona, is known only from Schott's notes and very poor specimens, and has never been identified since. Its panicle is likewise pubescent; its leaves short, narrow and very thick, with few thin fibres. It may possibly be a small-leaved form of *Y. macrocarpa*, which also shows a few thin fibres on the leaves. Both are recommended to the study of observers.

V. NOTES ON AGAVE.

FROM THE TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS, VOL. III. pp. 291–322; pp. 3–35 OF REPRINT ISSUED DECEMBER, 1875.

JUST as the Yuccas among the Liliaceous plants, of which I have treated in a former [291 (3)] paper (vol. III, pp. 17 and 210), the Agaves present among the Amaryllidaceæ a peculiar, gigantic, and sometimes tree-like development, not otherwise found in these families. Like the Yuccas, they are confined to the New World; but, unlike them, which are represented by only about a dozen species, of a more or less uniform and unmistakable character, the Agave type branches out in perhaps a hundred (or 180 or 200, if we dare trust the catalogues of nurserymen) species, of greatly diversified appearance.

The botanical investigation of the Agaves meets with the same difficulties as that of the genus above mentioned in connection with them, the Yuccas, and as the Cacti, or, to use a term more of horticultural than botanical significance, but sanctioned by the authority of no less a name than that of the elder DeCandolle, the *plantes grasses*. They have, for the most part, been long in cultivation, the individuals being propagated with their individual peculiarities by suckers, and very rarely by seeds. Many of them have never bloomed in Europe, and many that did bloom have not been studied by competent botanists; of a large number, their native country is unknown, and the travelling horticultural collectors have paid more or chief attention to marketable plants than to botanically-instructive specimens. Moreover, most of these plants are so clumsy and so difficult to properly preserve for the herbarium that travellers have shunned them; so that even the standard herbaria mostly contain only very scanty and incomplete material.

In the old United States only a single representative of the genus was known, the *Agave Virginica*, a rather small and inconspicuous plant, if compared with the extensive development the genus attains in Mexico and further south, in the number of species as well as in the bulk of individuals. But on our southwestern border lands, the same region where the Cacti become a leading feature of the Flora, the botanists of the U. S. and Mexican Boundary Commission, twenty to twenty-five years ago, discovered a greater development of the genus, and Prof. Torrey in his [292 (4)] Botany of that Boundary (published in 1859) was able to indicate five other species; his account, however, owing to an insufficiency of material, is meagre and to some extent erroneous. As far as I am informed, nothing has been added to our knowledge of these plants in the sixteen years elapsed since his publication; but in the last few years a quantity of new material has been gathered, and, being placed at my disposal, has enabled me to make a more thorough study of the genus.

The Agaves are American plants, some of which became known to Europeans since the discovery of America, and especially since the conquest of Mexico: the great *Agave Americana* is said to have been already in cultivation in Europe as early as the year 1561; from the similarity of the spinous leaves they were considered forms of the Aloes of the Old World, and the name "Aloe" has in popular language stuck to them to this day. Linnæus was the first to distinguish them; and in his Hortus Upsalensis (1748), p. 87, he established the genus *Agave*, and enumerated the characters by which "these American plants" are readily known from the true "Asiatic and African Aloes."

He adds that he has "named them *Agave*, because that word indicates something grand and admirable." It is interesting to observe how even at that early date, when botanical geography was not yet born, the geographical domains of these different groups of plants struck the discriminating mind of Linnæus as something remarkable and characteristic.

The AGAVEÆ were first recognized as a distinct tribe by R. A. Salisbury,[1] who united in his 12th order of *Sarmentaceæ* Yucca (with a "pericarpium superum") and Agave, Polyanthes, and others (with a "pericarpium inferum"), thus recognizing the great resemblance of these plants, which we now place in different but parallel families, just on account of the relation of the ovary to the other parts of the flower.

Other botanists[2] have appended them to the *Amaryllidaceæ*, but it must be confessed that they have only the inferior[3] ovary in common with the true bulbiferous Amaryllidaceæ, [293 (5)] distinguished by a naked scape and an involucral spathe. The numerous horizontally-flattened black seeds, mentioned already by Salisbury as being common to Yucca and Agave, are not found in the true Amaryllis family; nor do these possess the filiform embryo which diagonally traverses the whole length of the albumen. Other interesting differences are found in the valvate æstivation of the Agaveæ and in their commissural[4] stigmas, while the true Amaryllidaceæ have an imbricate æstivation and carinal stigmas. and so have Yucca and perhaps all Liliaceæ.

TRUNK.

The majority of the Agaves are acaulescent and monocarpic; the short subterranean trunk continues to grow for years[5] until vigorous enough to evolve the flowering stem, — a continuation of its axis, — and dies after bearing fruit. During its growth a wreath of numerous thick, fleshy, white root-fibres is developed every spring from its lower part, while the lowest, oldest part of the trunk dies and rots away. This is the case at least in *Agave Virginica*. A few Agaves have persistent trunks, sometimes of considerable dimensions; these produce flowers repeatedly, just as the caulescent Yuccas do, from axillary branches, after the terminal bud of the main axis has fulfilled its destiny and died. These secondary branches are initiated by a pair of short and clumsy, strongly carinate leaves, which may be considered as representing bud-scales (*Niederblaetter*), as I noticed in vigorous specimens of *A. Boucheana*, Jacobi, and *A. chlorocantha*, Salm, in the Berlin botanic garden, 1869.

In the acaulescent Agaves the subterranean trunk dies entirely, or for the greater part; but in *A. Americana*, and probably in the majority of the species, it first emits from the axils of decaying leaves numerous offshoots, which grow into separate young plants and thus propagate the individual. In *A. Virginica* it produces sessile lateral buds, which grow up, still adhering to the persistent part of the old trunk, a sort of corm, giving to the plant eventually a cespitose ap- [294 (6)] pearance. Polyanthes behaves just in this manner.

The subterranean trunk of most (or all?) Agaves contains, like that of Yuccas and many other plants of these families, a great deal of mucilage,[6] which, mixed with water, has detergent qualities to a considerable degree: these "roots" and the whole plants thus used are known to the Mexicans by the name of *Amole*. Another use is made of the trunk, when before flowering it has developed a large quantity of saccharine matter, — for nourishment; and not only the trunk of Mexican Agaves,

[1] Genera of Plants, ed. 1866, p. 77.

[2] Endlicher, gen., p. 181; Kunth, Enum. 5, p. 818.

[3] In *Agave* the ovary is truly and entirely inferior, but the closely allied *Polyanthes* shows a partly (about ¼) superior ovary.

[4] Stigmas formed by the *commissures* of the carpels, therefore alternating with these, — a comparatively rare case. The common form is the carinal stigma, formed by the tip of the carpel itself or its carina, therefore opposed or rather superimposed to the carpel.

[5] In *A. Americana*, in its home, eight to fifteen or more years; under more unfavorable circumstances, in cultivation in colder countries, much longer, even, it is said, fifty or a hundred years, whence the name *century-plant*.

[6] The suggestion made (p. 21) that the rootstock may contain saponine, has not been verified by chemical analysis.

but also that of the larger Arizona species, is thus eaten, after baking, under the name of *Mezcal*, and is said to be a very savory dish. The name *Maguey* is more commonly used for the plant itself.

LEAVES.

The leaves of the Agaves are sessile with a broad sheathing base, from linear to lanceolate or even ovate, the broader ones contracted above the base, and widened again upwards. They are thick and fleshy, sometimes soft, but usually of a firmer texture, rarely quite tough and hard; in some species (only in the first group) they decay at the end of the season, but in most Agaves they are persistent for years.

The margin of the leaf usually bears hard and dark-colored straight or hooked or variously flexed spiny teeth; sometimes it is denticulate with minute, pale teeth; rarely it dissolves, Yucca-like, into threads; in our *A. parviflora* it combines the teeth on the lower half with the fibres on the upper half of the leaf; very seldom the edge of the leaves is entire; in some species the whole margin of the leaf bearing the spines becomes dry, hard, and horny, and is eventually, together with the spines, detached from the leaf (*A. heteracantha*). It is not well known whether the spines, so much relied on to characterize the different forms, are sufficiently constant; it seems, at least, that an extensively cultivated form of *A. rigida*, of Yucatan, has lost its spines, and produces them only occasionally and very sparsely; in the allied genus *Fourcroya*, leaves with and without marginal spiny teeth are of common occurrence.

The point of the leaf forms a soft herbaceous bristle, or usually a hard and pungent [295 (7)] spine, of different shapes, round, or compressed sideways, or flattened on the upper surface, or concave, or channelled; and these characters seem to be constant and of specific value.

The tissue of the leaf of most Agaves contains innumerable extremely tough fibres, which, in some of the species with sufficiently long leaves, afford, when freed from the surrounding parenchyma, valuable textile material, usually called *Pita*, in general use in their native countries, and even exported. *A. Americana* furnishes a coarser Pita; *A. rigida*, and its cultivated varieties are the source of the finer Sisal hemp; other species, e. g. *A. heteracantha*, are locally used for the same purposes.

INFLORESCENCE.

The flowering stem or scape shoots up from the centre of a rosette of leaves, continuing the main axis; it bears numerous bractlike leaves (*Hochblaetter*), generally triangular from a broad base, often attenuated into a slender tip, smaller as they reach up into the inflorescence. All the vigor of the plant, all the nourishment accumulated in the massive leaves and in the succulent trunk, are used and exhausted in the production of the inflorescence. It is well-known that *A. Americana* is extensively cultivated in Mexico, principally for the immense quantity of saccharine juice prepared in its leaves for this purpose. When the flowering scape shows the first signs of development, the terminal bud and the innermost leaves are removed, when in the basin thus formed the liquid collects and is dipped out; on an average about a gallon a day, for two or three months in succession; from a single plant 150 to 300 gallons in all. From this juice the fermented (*pulque*) and distilled (*mezcal*) liquors are prepared which are so generally used all over Mexico. The juice which is extracted before the plant prepares to bloom is acrid and not copious.

The flowering stems are in the different species from 3 to 20, and, it is said, even 30 feet high, and from a few lines to 3–5 inches in diameter, together with those of the allied Fourcroyas, the tallest flowering stems known.

The flowers are articulated on (usually extremely) short, persistent pedicels, bearing [296 (8)] one or two small bracts. The inflorescence itself shows three different forms, and, accord-

ing to these, the numerous species of this genus naturally are distributed in three different sections.

The first section, *Singuliflorœ*, to which our *A. Virginica* belongs, bears single flowers in a simple, generally slender spike, never crowded as the spikes of the next section are; each flower is borne in the axil of a bract on a short pedicel, which is distinguished by a single lateral bractlet. This bractlet is normally sterile, but in monstrous inflorescences may produce secondary and tertiary flowers, which, however, can always be distinguished from those of the next section by never appearing in pairs.[7]

The second section, *Geminiflorœ* (gen. *Littœa*, Tagliab., *Bonapartea*, Willd., non. Ruiz & Pav.), comprises the species which produce flowers in pairs, crowded into a more or less dense spike. From the axil of each primary bract a short or rarely longer (e. g. *A. Utahensis*) peduncle originates, bearing two opposite lateral bracts (sometimes pushed somewhat toward the main axis), and in their axils the flowers on two short (rarely, e. g. in *A. attenuata*, Hort. Cels. Paris, 1869, longer) secondary pedicels with bractlets of the third order directed toward the primary bract. These bractlets occasionally bear a second pair of flowers with lateral bractlets of the fourth order, directed inward, and in the axils of these occasionally (*A. attenuata*) rudimentary flower-buds are seen. An internal perigonial lobe of the flowers of the primary pair is directed backwards and outwards toward the margin of the primary bract, and an external lobe toward the bractlet. In rare instances the primary peduncle does not terminate abruptly, as usual, but is continued [297 (9)] into a bristle between the flowers (*A. mitis* in H. Bot. Berlin), and may even bear a third, median, flower, if the description of the inflorescence of *A. lophantha* by Jacobi (Ag. p. 202) is to be relied on; the flowers are there said to be ternate, the pedicel of the middle one being one line longer than those of the lateral ones.[8]

The species of the third section, *Paniculatæ*, are distinguished by a branching inflorescence, a panicle, in which more or less crowded bunches of flowers are borne on the end of secondary or tertiary branches. I have not been able to examine fresh inflorescences or their development, but, judging from dried fragments, the flowers seem originally to appear in pairs, usually with secondary and tertiary flowers unsymmetrically developed from their pedicels, and at last clustered, sometimes 20 or 30 or more together, so that their relative position cannot be unravelled.

FLOWERS.

The flowers of the Agaves are thick and fleshy, often of lurid, greenish, yellowish, or brownish colors; rarely brighter, yellow (*A. deserti*), or orange (*A. Antillarum*). They consist of an inferior ovary, bearing the style, and a not articulated, subpersistent perigone, with the stamens.

The perigonial tube, straight, or often somewhat curved, is either short, campanulate, sometimes quite shallow, or longer, funnel-shaped, or even cylindric, or rather triangular-prismatic. The lobes

[7] I have a plant of this species growing, brought from the woods in this vicinity, which produces its irregularly crowded flowering spikes every year in the same manner. The lateral bractlet usually bears a second flower on a similarly bracted pedicel; this second bractlet stands either on the dorsal (toward the principal bract) or on the ventral (toward the main axis) side of the little inflorescence; a third flower, if present, is not coeval nor opposed to the second one, but later and higher up, and usually on the upper or inner side of the second flower; if the antholytic development, which then is often combined with fasciation, proceeds, parts of the primary flower may become more or less detached and again bear incomplete axillary flowers. — It may here be remarked that the flower of the Singuliflorœ is so placed in regard to bract and axis, that an external lobe of the perigone and one carpel are turned toward the bract, and an internal lobe and the commissure of the other two carpels toward the axis. That abnormal stock, however, produces sometimes toward the tip of the spike flowers without a pedicel and without a lateral bractlet; in these one external lobe and one carpel are turned toward the axis.

[8] Some forms are described so as to leave us in doubt in regard to their inflorescence, e.g. *A. horizontalis*, Jacobi, with a spike consisting of clusters of 3–8 flowers in the axil of each bract; others are said to have 1–3 or 4–5 flowers together. All these probably belong to the Geminiflorœ, with a greater normal or, perhaps, monstrous development of flowers. It is to be hoped that in future botanists or amateurs will be more precise in their appreciation of these characters.

form two trimerous verticils, each of valvate æstivation, the thicker exterior ones covering the broader thinner margins of the interior ones, leaving only a prominent tapering middle part free. The lobes are generally oblong or linear-oblong, shorter or longer than the tube, flat or often channelled and including the filament, concave at the obtuse tip, which is sometimes thickened, and usually bears a short, whitish beard; they are erect or patulous, or sometimes at last reflexed.

The six stamens are more or less adnate to the tube, in some species free from near [298 (10)] its base, in others adnate up to the base of the lobes (an important character which has often been neglected); the outer stamens are usually placed a little higher than the inner ones. In the bud the filaments are always doubled up,[9] geniculate, and straighten out when the flower opens, and almost always become much longer than the perigone; in a few species they do not exceed the length of the lobes. The filaments are generally attenuated from a broader base and terminate in a thin point, on which they bear the large and conspicuous linear,[10] nearly quadrangular, somewhat introrse, 4-celled, versatile anther, attached near or a little below the middle; in *A. Virginica* the filaments are thickened upwards, almost clavate. The globose, or elliptic, delicately reticulated pollen-cells have, on an average, a diameter of 0.06 to mostly 0.08 or even 0.11 mm.

The ovary consists of three carpels, opposite the outer perigonial lobes, forming three cells, in each of which two vertical rows of flat, horizontal, anatropous ovules spring from the central placentæ. The stout, somewhat triangular, tubular style rises to the height of the anthers and sometimes above them, but its length is variable and does not seem to be always characteristic. The stigmatic part is thickened, clavate, or somewhat capitate, and is divided into three carinal[11] lobes, which at last open somewhat or, especially in the first section, expand horizontally, and are often emarginate or even obcordate; after expansion they (at least in *A. Virginica*) exude a viscid liquid — whether stigmatic or only intended to allure insects, has not been ascertained.

The flowers of Agave (I speak particularly of *A. Virginica*, the only one I have been able to observe in its development, but I suspect that the same holds good in all the species) are vespertine or nocturnal and proterandrous. They open late in the afternoon or in the evening, and, while the filaments straighten out and elongate, the anther-cells burst and emit the large pollen grains, and on the following morning are found withering and empty. The style at this period usually does not yet exceed the perigone (in *A. maculosa* it is much shorter), and its lobes are [299 (11)] firmly closed; but now it begins to elongate and attains its functional maturity 48 hours after the anthers have opened, which by this time have mostly fallen off.*

The Agave flowers are odorous, some of them, like *A. Virginica*, of the sweetest fragrance, resembling tuberose, though not so overpowering; others are more or less fetid. These odors are most fully developed, as is also the case in the tuberose, in the evening and at night, indicating undoubtedly the design of attracting vespertine insects to assist in pollenization. But whether insects aid in this process, or the higher-placed flowers drop their pollen from the just bursting anthers on the opening stigmas of the lower and older ones, has not been ascertained.

The fruit is always an erect, dry, 3-celled capsule, globose or even depressed, or ovate, oblong and sometimes prismatic, obtuse at base or contracted into a sort of a stipe, obtusish at tip or acute or rostrate, opening above, generally about the upper third or half only. The numerous horizontal seeds are flat, black, semi-orbicular or obliquely orbicular with a shining or opaque surface, which, magnified 100 or 150 diameters, shows the epidermal cells flat and scarcely distinct from one another, or with distinct somewhat elevated cell-walls; or they are slightly depressed, giving the

[9] Even the short filaments of *A. maculosa* are thus geniculate. (See p. 301, note.)

[10] The curved anthers spoken of in some descriptions can only refer to effete and withering ones.

[11] See page 293, note.

* In figures of Agave flowers we not rarely meet with bursting anthers and a fully elongated style in the same flower; which I suppose is factitious, and not founded on correct observation. — See a brief note on this subject, by Engelmann, in Bull. Torrey Bot. Club, 1872, III. 37. — Eds.

seed a pitted appearance, or rarely elevated and tubercular. The areæ of these cells are very minutely dotted or pitted.

The filiform, cylindric, or slightly compressed embryo is as long as the hard, whitish, semi-transparent, farinaceous and oily albumen. In germination the seed-shell is elevated above the ground on top of the largely developed foliaceous cotyledon, contrary to the behavior of Yucca, where the husk enclosing the small and soon decaying cotyledon remains buried in the ground. (See Notes on Yucca, 3, p. 20.)

Some species bear no fruit, but, in place of the withered flower, or probably in the axil of its bractlet, a bud or bulblet appears, which grows to a considerable size and will eventually sprout and propagate the plant. All the so-called viviparous Agaves belong here. Some [300 (12)] species, *A. Ixtli*, Karw., in the garden of the late Mr. Thuret of Antibes, bears both capsules and bulblets; and so appears to do *A. sobolifera* (*A. vivipara*, Lam.) None of our species possess this peculiarity.

The native country of the Agaves is pre-eminently Mexico; in the southwestern parts of the United States, mostly in Arizona, 13 species are found; but only one of these extends to the 39° and even 40° N. Lat., while in California the northern limit of the Agaves is about 34°. A few species seem to be natives of the West Indies, and a few more may be peculiar to South America. The Agaves said to come from the East Indies, St. Helena, and other parts of the Old World, are probably all forms of *A. Americana* originally brought there from America.

I now proceed to the enumeration of the species of the territory of the United States, and of a few undescribed or imperfectly known foreign Agaves of which I possess sufficient material.

AGAVE, *Linn.*

Perianthium superum tubulosum vel campanulatum, subregulare, subpersistens, limbo 6-fido, laciniis valvatis. Stamina 6; filamenta tubo plus minus adnata, in alabastro inflexa, demum plerumque longe exserta; antheræ lineares versatiles. Ovarium inferum, triloculare, ovulis anatropis horizontalibus in loculo singulo biseriatis; stylus apice incrassato trilobus. Capsula coriacea, loculicide trivalvis; semina 6-seriata numerosissima, plano-compressa, nigra; embryo axilis, longitudine albuminis cornei.

Plantæ Americanæ, præcipue Mexicanæ, acaules vel caulescentes, sæpius giganteæ; foliis crassis sæpissime aculeato-dentatis spinoso-mucronatis.

I. SINGULIFLORÆ.

Flores e bractearum axillis singuli, laxe spicati.

The species of this section have a more herbaceous character than those of the two others; they are stemless with softer, probably always annual leaves, not contracted above the base, with marginal asperities more than teeth, and a terminal bristle more than a spine. They are the *Herbaceæ* and *Subinermes* of authors, which, however, include some species of the next section. Only about a dozen species are known, three of them within our [301 (13)] domain. The spikes are slender, the flowers fragrant, the stigmatic lobes wide-spreading.

1. AGAVE MACULOSA, *Hook. Bot. Mag.* 1859, t. 5122: foliis e caudice subterraneo crasso cylindrico lanceolato-linearibus concavis undulatis demum recurvatis glaucis lurido-maculatis cartilagineo-denticulatis; spicæ laxifloræ bracteis lanceolato-subulatis; ovario ovato-lanceolato brevi, lobis lineari-oblongis erecto-patulis tubo gracili subcylindrico sursum parum ampliato plerumque multo brevioribus, staminibus fauci ipsæ insertis lobos vix æquantibus stylum plerumque superantibus, stigmatibus demum patulis obcordatis; capsula oblonga longe cuspidata basi in stipitem contracta. — *A. maculata*, Engelm. in Bot. Mex. Bound. 1859, p. 214, non Regel; *A. Virginica*, Torr. ibid., non al.

Var. β. BREVITUBA: lobis perigonii tubo magis ampliato fere æquilongis, antheris longioribus.

Along the Rio Grande from below El Paso to Matamoros, Wislizenus, 1847; Bigelow, Schott, 1850–52; the variety below El Paso, Wright, No. 1905. — Flowers May and June. — The caudex, somewhat different from the allied species, is a black cylindric stock ½–¾ inches thick and 4–6 inches long, bearing thick white radical fibres at the base. Leaves ½–1 foot long, as many inches wide, concave, flexuous, at length recurved; scape 2–4 feet high, spike 6–12 inches long; fragrant purplish-green flowers, about 2–2½ inches long; ovary 3–4 lines, tube 1 inch and lobes 7–9

lines long, filaments[12] and anthers as long as lobes. The stigma is remarkable on account of the deep emargination, almost bilobation, which form is only indicated in other Agaves, but is distinct in Polyanthes. The firmer texture of the capsule (1½ inches long, ½ inch thick), and its stipe and beak, further characterize this species. Seed 2–2½ lines wide, thicker than usual in this genus, marked by a flat reticulation.

2. AGAVE VIRGINICA, *Linn.*: acaulis; foliis late seu oblongo-lanceolatis concavis undulatis flexuosis demum recurvis læte viridibus herbaceo mucronatis margine asperatis; perigonii ovario ovato multo longioris tubo angusto sensim ampliato lobis lineari-oblongis erectis bis terve longiore, filamentis inferiori tubi parti adnatis sursum clavatis perigonium vix duplo superantibus, stigmatibus suborbiculatis demum patentibus; capsula tricocca subglobosa retusa breviter stipitata. [302 (14)]

Var. β. TIGRINA: robustior; foliis majoribus pulchre purpureo-maculatis; staminibus imo tubo adnatis; capsulis depresso-globosis.

Lusus POLYANTHUS: spica densiflora in glomerulos paucifloros congestis sæpius antholyticis.

On dry hills and in open woods from Maryland and Virginia southward and westward to Missouri and Texas, but not on the western plains or in West Texas, nor on the Rio Grande; the variety near salt-marshes on the coast of South Carolina, Dr. Mellichamp. — Flowers June to August, according to latitude. — This species was first known through Clayton's collection, who described it as "Aloe from Virginia," and makes mention of its fragrant flowers and deciduous leaves; from his specimens and notes it was published by Gronovius in his Flora Virginica, 1739, and through him became known to Linnæus, who in 1751 (Amœn. Acad. 3, p. 22) referred it to his new genus Agave.

Leaves mostly ½–1 foot long, 1½ or 2 inches wide; in a form from Houston, Texas, the leaves are lance-linear and not more than half as wide; marginal teeth extremely small, consisting of single projecting epidermis cells, or larger, $\frac{1}{20}$ to (rarely) ¼ line long, and then consisting of innumerable short cells, not sharp-pointed, but rough, like the small serratures of some Yuccas, only less rigid. Scape altogether 3–5 feet high, of which the spike measures 1 or 1½ feet. Flower, including ovary but excluding stamens, — as I always measure Agave flowers, — 1–1¼ inches long, with the stamens ½ or rarely 1 inch longer; anthers 6–6½ lines long. Capsules 7–9 lines long, a little less wide; seeds 2–3 lines wide, lightly reticulated, with depressed, minutely dotted areas.

Var. *tigrina* is larger and more robust; leaves tapering to a point or abruptly cuspidate, 1–1½ feet long 2½–3 inches wide, beautifully mottled; the purple color is produced by a clear purple liquid contained in a single layer of small flattened cells between the transparent epidermis cells and the large parenchymatous cells filled with chlorophyll and often with rhaphides; capsule 8–9 lines wide, less high; seeds over 4 lines wide. This variety has retained its peculiarities in cultivation with me. [303 (15)]

Of the sport with crowded, often antholytic flowers, and with a tendency to fasciation, I have before spoken (p. 296, note).

3. AGAVE VARIEGATA, *Jacobi, Hamb. Gart. Zeitg.* 21, p. 459; *Agav.* p. 180; *Saunders Refug. Bot.* v. t. 326: acaulis; foliis late lanceolatis undulatis margine asperato denticulatis; perigonii tubo late infundibuliformi ovario oblongo paulo longiore lobos ovato-oblongos patulos demum reflexos longitudine æquante seu eis paulo breviore, filamentis superiori tubi parti adnatis longe exsertis, stylo demum stamina superante; capsula oblonga cuspidata.

On the lower Rio Grande near Mier and Matamoros, Dr. J. Gregg, May, 1847. — Leaves (before me) 9–10 inches long, 1½–2 inches wide; edge similar to that of the last, but teeth often sharper and curved upwards; scape "3–5 feet high"; flowers in Dr. Gregg's specimen about ¾ inch apart, in the axil of a broad triangular bract, 4 lines long, upwards smaller. Flowers 1½ inches long; ovary, tube, and lobes, of nearly equal length, 6 lines, or tube a little shorter and lobes a little longer; stamens inserted about ⅔ or ¾ up the tube, not at the base of the lobes, and about 2 inches in length; anthers ½ inch long; style slender, at last often longer than the stamens; only capsule seen 10 lines long and 6 wide; seeds unusually oblique (always?), 2½ lines in longest diameter.

I refer this plant from the Rio Grande with some hesitation to Jacobi's and Saunders' *A. variegata*, the stamens of which are said to be inserted "in the throat," whatever that may mean; the leaves of this plant, which is said to be "probably" from Mexico, and which has repeatedly flowered in Europe, are mottled with lurid blotches, of which in my dried specimen no trace is visible. I have not the means to ascertain whether any of the older names, such as *A. brachystachys*, Cav., or *A. polyanthoides*, Hort., refer to this same plant; the former, however, seems to be a larger plant, with larger "entire" leaves; *A. saponaria*, Lindl., is certainly also similar, but, if the figure in Bot. Reg. 25 t. 55 is to be relied on, is well distinguished by having a prismatic flower-tube. The insertion of stamens in the tube is not mentioned by Lindley, nor is it scarcely ever spoken of in any descriptions, nor indicated in the figures. [304 (16)]

[12] This is one of the few Agaves with stamens so short that they may be called *included*; they occur in all three sections. It is not impossible that superficial investigation has classed several of these American plants with the Asiatic genus *Polyanthes*; but they have — at least this one has — an entirely inferior ovary and filaments doubled up in the bud, both of which characters are wanting in Polyanthes. Kunth (En. 5, p. 48) already suggests this in regard to *Polyanthes Mexicana*, Zucc.

II. GEMINIFLORÆ.

Flores e bractearum axillis bini oppositi, dense spicati.

The species appertaining to this section, 40 or 50 in the books, 4 of which belong to our Flora, are usually stouter, sometimes with a short trunk, leaves rarely soft and almost herbaceous, but perhaps always perennial, often tough and sometimes the toughest in the whole genus; their margin is most variable, entire, or with small pale cartilaginous teeth, or filamentose, or with stout, horny brown spines. — Together with the first section they constitute the *Agavæ spicatæ* of some authors; others, who have principally regarded the growth and foliage of cultivated plants, have scattered them in various groups, mixed with the species of the next section.

* Folia margine serrulato-aspera.

4. AGAVE FALCATA, *n. sp.:* acaulis; foliis e basi lata linearibus rectis seu plerumque falcatis rigidissimis supra planis concavisve (siccatis) dorso carinatis margine serrulato-asperatis apice in spinam fere triangularem supra planiusculam excurrentibus; scapo et spica bracteis e basi latiore subulato-filiformibus marcidis deciduis stipato; ovario lobisque perigonii ovatis erecto-patulis eo æquilongis tubo multo (ter) brevioribus; staminibus medio tubo vel ultra insertis perigonium fere duplo superantibus; stylo gracili apice trilobo.

Saltillo, Buena Vista, and apparently all over that northern part of Mexico, abundantly collected by Drs. Wislizenus and Gregg in 1846–48; flowering in the latter part of May, and again in July and August, probably at different seasons, as many Mexican plants do, stimulated to development by a few rains or even a single heavy one. — As the plant is common in a region often traversed by collectors, it seems strange that it should not have become known and been brought into cultivation long since; but I can find no description which I might refer here, unless it be the *A. Californica*, Hort. Kew, of which I find a notice in Jacobi's Agave, App. p. 47; but I strongly suspect that this refers to no Agave at all, but to *Yucca Whipplei*.

Leaves hard and rigid, finely serrulate, 6–15 inches long, sheathing base 1–1½ inches wide, soon [305 (17)] contracted to the width of 3–5 or 6 lines, tapering to the point, the sharp brown spine of 6 lines in length, triangular, nearly flat above, with two sharp lateral and one obtuse carinal edge; leaves usually falcate, rarely straight. Scape "3–8 feet high," bearing arid filiform bracts of 2 inches or more in length, smaller in the inflorescence. Flowers crowded on very short knobby pedicels, 12–15 lines long, ovary and lobes each 2½–3, tube 6–7 lines long, and at the throat nearly 3 lines wide; filaments inserted just above the middle of the tube, reaching about 1 inch above the perigone; anthers 7 lines long. Fruit not collected.

* * Folia margine filamentosa.

5. AGAVE SCHOTTI: acaulis; foliis e basi lata linearibus rectis seu subfalcatis rigidis supra planis concavisve dorso convexis seu (siccatis) carinatis margine abunde filiferis apice in spinam robustam teretem fuscam excurrentibus; pedicellis brevibus, ovario et lobis perigonii patulo-erectis lineari-oblongis æqualibus tubo anguste infundibiliformi multo brevioribus, staminibus superiori tubi parti adnatis paulo exsertis; stylo robusto staminibus demum æquilongo. — *A. geminiflora?* var. *Sonoræ*, Torrey, Bot. Mex. Bound. 214.

Sierra del Pajarito in Southern Arizona; flowers August; collected only by the late Dr. Arthur Schott, 1855, to whose memory I have dedicated this species in consideration of long years of friendship and of the valuable services to science rendered by him in many arduous exploring expeditions in the arid southwestern wilds, as well as in the primeval tropical forests of the isthmus and on the plains of Yucatan.

According to the discoverer, this as well as the next is one of the *Amole* or soap-plants. Leaves 6–12 inches long, 3–4 lines wide, terminating in a perfectly terete spine 3 lines long; margin splitting into numerous extremely fine whitish fibres. Scape 5–6 feet high; spike rather looser-flowered than in the last; primary and secondary pedicels about 1 line long: flower 1½ inches long, ovary as well as narrow lobes about 5 lines, the gradually widening tube 8 or 9 lines long, and bearing the filaments (8 lines long and reaching scarcely more than 1 line beyond the lobes) 1½ lines below the throat; anthers 5–6 lines long, large for the flower; no fruit seen.[13] [306 (18)]

6. AGAVE PARVIFLORA, *Torrey, Bot. Mex. Bound.* 214: parvula, acaulis; foliis rosulatis terræ adpressis e basi lata vaginante dentata lineari-lanceolatis margine infra brunneo-dentato sursum in filamenta brevia crassa alba soluto, spina terminali rigida supra plana; scapo elatiore, pedicellis brevissimis; floribus geminis seu subquaternis parvis, ovario oblongo perigonio duplo breviore, tubo profunde campanulato lobis oblongis erectis bis longiore, filamentis basi tubi insertis subinclusis; capsula pisiformi subglobosa breviter cuspidata.

[13] Dr. Gregg collected near Ocotillo, direction of Tepic, in Western Mexico, leaves of a plant which he says bears a scape 5–6 feet high, and which, like many narrow-leaved Agaves and Yuccas, was called *Palmilla* by the natives; unfortunately no flowers came along, but, as it seems to be an undescribed Agave, it may be designated as A. ANGUSTISSIMA: leaves "2–3 feet long," 2½–3 lines wide, convex on the back, filamentose on the margin, narrowed into a short (2½ lines), stout, triangular, brown spine. It seems allied to *A. filamentosa*, Salm, which, however, has much shorter and wider leaves. The form of the terminal spine precludes its being taken for a Yucca.

On various sierras in the Pimeria Alta in Southern Arizona, in flowers and fruit in July, A. Schott. — The leaves of this prettiest and smallest of all Agaves are, together with the broad, sheathing base, not quite 3 inches long; base 1 inch wide and a little longer; blade 1¾ inches long, 4 lines wide, somewhat contracted above the base; spines 2 lines long, at last gray. On its lower third or half the leaf-margin bears very small, but rigid, sharp teeth, and higher up separates into a few short, stout, white filaments, — the only instance of this combination, I believe, in the whole genus. Scape 4–5 feet high. Flowers 6, ovary over 2, tube 2½, and lobes 1¼ lines long, with stamens and style about 4 lines in length and scarcely reaching beyond the lobes of the perigone; anthers 3, capsule 4–5, and seeds 1¾ lines long.

* * * Folia margine aculeato-dentata.

7. AGAVE HETERACANTHA, *Zucc. in Act. Leop. Car.* 16, 2, 675; *Kunth, En.* 5, 836: subcaulescens; foliis crassis rigidis lineari-lanceolatis in margine corneo demum soluto aculeos complanatos uncinatos gerentibus, spina terminali valida subterete versus basin leviter exarata; scapo et spica bracteis e basi triangulari subulatis marcidis demum deciduis ornato; floribus in pedicellis brevissimis binis, perigonio ovario oblongo longiore, lobis [307 (19)] lineari-oblongis erecto-patulis tubum campanulatum brevissimum multoties superantibus, filamentis basi loborum insertis perigonio fere duplo longioribus; capsula ovata s. oblonga plus minus cuspidata. — *A. Poselgeri*, Salm, in Bonplandia 7, 92; Jacobi, Agav. p. 40; *A. Lechuguilla*, Torr. Bot. Mex. Bound. 213.

On the Rio Grande from El Paso down the river, Wright, 682, 1432, 1907; southward to Parras, Saltillo, and further, Gregg, Wislizenus; Karwinski, Poselger. Flowers in May. — I have ventured to unite the different forms under the oldest (Zuccarini's) name, the more so as I was able to compare the original specimen in the Munich botanical garden, where I found it in flower in August, 1869. Whether several other garden-forms, described under different names, all characterized by soluble corneous leaf-edges, belong here, or constitute distinct species, can be decided only when their flowers become known. Zuccarini's typical specimen has leaves 18 inches long and 2½ inches wide, with a spine 1½ inches long, the spiny teeth straight or curved up or down, whence the specific name; scape 6 feet high; flowers only 1 inch long (ovary 5, perigone 7, tube over 1½, filaments 15 lines long from base of tube); no fruit was matured, but many bulbilli were sprouting from the top of the scape. Gen. Jacobi (Ag. app. p. 14) describes a specimen which flowered at Brussels with perigone divided to the base, most probably inaccurate, as no Agave is known with such a flower.

Our plant grows in mountainous and rocky localities, is called *Lechuguilla* ("Lecheguilla" in the Mex. Bound. Bot. is a misprint), and its rootstock *Amole;* the leaves furnish excellent but rather coarse fibre, and the rootstock is used as soap and is a "savory food" when roasted; trunk 4–6 inches high; leaves (before me) 10–20 inches long and 1–1½ inches wide, margin and its teeth dark red-brown, at last fading to ash-color and becoming detached from the leaf, but adhering long to the terminal spine; teeth 9–12 or 15 lines apart, below smaller and straight, upward larger (1½–2 or even 3 lines long) and strongly uncinate, not irregular, as in the original specimen; terminal spine 7–9 lines long, slightly grooved on lower third or fourth. Scape 6–10 feet high, its bracts from 2 inches down to ½ inch long, deciduous, so that in the flowering spike little of them is seen. The flowers before me indicate two forms, one with a slender ovary, 7–9 lines long, larger flower (perigone 9–10, tube 1–1½, anthers 6 lines long), and [308 (20)] oblong, strongly cuspidate capsule, about 1 inch long and half as wide; the other form has a shorter ovary, 5–7 lines long, smaller flower (perigone 7–8, tube ½–1 line long), and rather shorter anthers, capsule shorter, 8 lines long and 6 wide, with a short abrupt point. Both forms seem to occur in all the localities mentioned, and certainly belong together. I have been particular in describing them, because we rarely have occasion to study numerous and varying specimens of these plants, but must be generally satisfied with poor fragments, so that it is difficult to ascertain the amount of variation within the species.

8. AGAVE UTAHENSIS, *Engelm. in S. Watson's Bot. 40th Parall.* p. 497: acaulis; foliis crassis glaucis e basi lata attenuatis in spinam validam infra carinatam supra usque ad apicem late exaratam excurrentibus, margine aculeis rectis validis albidis dentato; bracteis scapi elati e basi lata subulatis marcescentibus; floribus (minoribus flavis) pedunculatis binis vel sæpius quaternis, ovario oblongo perianthio subbreviore, tubo late campanulato abbreviato lobis oblongis erectis ter quaterve breviore medio stamina limbum paulo excedentia gerente; capsula oblonga breviter cuspidata.

Southern Utah, about St. George, etc., extending into Arizona, Dr. E. Palmer, J. E. Johnson, F. Bischoff. — Leaves 6–12 inches long, 1–1¾ wide, not contracted above the wider base, very thick and rather hard, strongly marked with the impressions of the margins of the adjoining leaves; terminal spine about 1 inch long, pale or white in the specimens before me, with a darker base and tip, almost triangular in the cross section; lateral spiny teeth 1½–2 lines long and as wide, white with a darker base. Scape, together with the dense spike of 1–2 feet in length, 5–7 feet high; peduncles and pedicels distinct, in fruit often 3 lines long, ultimate ones shorter. Flowers scarcely 1, perigone about ½ inch long, lobes three times or more the length of the shallow and wide tube, which bears the stamens in the middle, not at the base of the lobes as many short-tubed Agaves do; filaments less than ¾ inch long, about 2 or 3 lines longer

than the lobes; anthers 5–6 lines long ; capsule 10–14 lines long, 4–5 wide ; seeds 1½–2 lines wide, marked with flat punctate areæ.

III. PANICULATÆ. [309 (21)]

Flores ad apices ramorum inflorescentiæ congesti paniculati.

These are the typical Agaves, of which 20 or more forms are enumerated, with stout, often very large, fleshy leaves, almost always with spiny marginal teeth and strong spiny tips, a stout and high scape bearing a paniculate inflorescence, the branches of which are usually ¼–2 feet long or even more, stout, vertically compressed, and naked up to the base of the branchlets or peduncles. Most of them are stemless, some have trunks several feet high, but none grow as large as some Yuccas do. Among them we find the economically and commercially most important Agaves, especially *A. Americana* and *A. rigida*.

* Tubus perianthii lobis multoties brevior.

† *Stamina tubi basi inserta.*

9. AGAVE NEWBERRYI, *n. sp.:* acaulis ; foliis e basi latiore sensim angustatis lanceolato-linearibus rigidis integris apice aculeo fusco semitereti supra canaliculato armatis ; scapo gracili, paniculæ angustæ racemiformis ramulis remotis bracteis lanceolatis breviusculis fultis abbreviatis paucifloris ; perigonii tubo campanulato brevissimo, lobis oblongis, staminibus infimo tubo adnatis. — *Agave, n. sp.?* Torrey in Bot. Ives Exp. p. 29.

Peacock Spring, Northwestern Arizona, west of the San Francisco Mountains, between them and the Colorado River, over 4,000 feet alt., discovered, when just beginning to bloom, March 31, 1858, by Dr. J. S. Newberry on Lieut. Ives' Expedition, and named for him in commemoration of his services to Botany in this and other western explorations. — This very peculiar plant, of which we unfortunately know so little, is so different from the other paniculate Agaves known to me, that their connection seems to be altogether artificial ; but for the present I cannot do better than to place it between them and the last section, to which the small stature and the form of the leaves seem to approximate it, though the inflorescence is clearly a contracted, short-branched panicle.

Leaves 7–10 inches long, at base ¾ inch wide, with entire, cartilaginous margins,[14] terminating in a sharp, semi-terete or almost triangular, dark colored spine, grooved on the upper side, and about ½ inch long. [310 (22)] Scape 8 feet high, flowers in a long, loose raceme or contracted panicle; bracts lanceolate, about ½ inch long ; branchlets 1–3 inches apart, 1–2 inches long, bearing 2–5 (not opposed) flowers. The whole flowerbud, just about opening, nearly 1 inch long; prismatic ovary equal to perigone; tube very short, only ⅛ or ⅙ of the lobes; short stamens, which, when fully developed, probably will not be much longer than the perigone, from near the base of the tube ; anthers 4½–5 lines long.

†† *Stamina tubi fauci inserta.*

10. AGAVE DESERTI, *n. sp.:* acaulis ; foliis crassis glaucis supra basin latissimam aculeato-dentatam leviter contractis ovato-lanceolatis sursum sensim attenuatis in spinam gracilem elongatam compressam ad medium anguste canaliculatam excurrentibus, margine sursum corneo obscuro infra herbaceo aculeis uncinatis flexuosis fuscis armato ; scapo graciliore bracteis distantibus foliaceis lanceolato attenuatis dentatis stipato, ramulis paniculæ superioribus erectis, pedicellis fasciculatis longiusculis ; floris flavi ovario subprismatico perigonium fere æquante, tubo infundibuliformi brevissimo lobis oblongis erecto-patulis quater s. quinquies breviore, staminibus loborum basi insertis ipsis lobis duplo longioribus ; capsula oblongo-prismatica breviter cuspidata.

Eastern base of the Southern California mountains and in the adjoining deserts. Flowers in June, but occasionally, as most of these plants do, at other seasons. — The then Lieut. Emory,[15] in the adventurous expedition to California in the fall of 1846, was the first to discover this species in Valcitron, southeast of San Felipe. A few years later Dr. Parry found it "on the arid hills and valleys" in the same region, and drew up a full description, but did not collect any specimens. Since then it was lost sight of until within this year, when horticultural collectors again brought it into notice. My specimens were obtained from Mr. G. N. Hitchcock of San Diego and Dr. E. Palmer.

The plant is one of the smaller of this section ; leaves densely clustered around the base of the stalk, [311 (23)] ascending and erect, thick, fleshy, deeply concave, very glaucous, 6–12 inches long, ½–2 wide, contracted above the very broad base, which is edged with sharp, straight, pale teeth, wider above the middle and terminated by an unusually long (1–2 inches) and slender, laterally compressed spine marked with a deep narrow groove half-way

[14] Possibly a horny tooth-bearing edge, such as we find in *A. heteracantha*, may have broken off, but no traces of such remain in the only extant specimen.

[15] In his Notes on a Military Reconnoissance, Washington, 1848, p. 104, he says, under date of Nov. 29 : "We rode for miles through thickets of the centennial plant and found one in full bloom. The sharp thorns terminating every leaf were a great annoyance to our dismounted and wearied men. . . . A number of plants were cut by the soldiers and the body of them used as food." A few flowers were saved, and are now in the late Dr. Torrey's herbarium.

up; the hard and horny, dark colored edge of this spine extends down to about the middle of the leaf, bearing the crowded strong hooked teeth (2–3 lines long); below the middle the teeth-bearing margin is herbaceous. The stalk is, according to Dr. Parry, 4–10 feet high, 1–2 inches thick below. The flattened branches of the panicle, almost horizontal below, longest (2–3 inches) in the middle and nearly erect upwards, divide into not very compact clusters of forked pedicels, 2–3 lines in length, the ultimate ones shorter, bearing a profusion of bright yellow flowers. Prismatic ovary a little shorter than the perigone and scarcely contracted at top; perigone 10–11 lines long, tube only $1\frac{1}{2}$–2 lines long and wide, lobes about 9 lines long and $2\frac{1}{2}$ wide; filaments inserted at base of lobes, about twice their length; anthers as long as lobes; capsule $1\frac{3}{4}$ inches long, 6–7 lines wide, pointed; seeds $2\frac{1}{2}$ lines in diameter.

11. Agave Parryi, *n. sp.:* acaulis; foliis ascendentibus rectis supra basin dilatatam vix angustatis ovato-lanceolatis versus apicem attenuatis spina valida supra planiuscula medio leviter carinata decurrente terminatis, margine aculeis distantibus minoribus rectis seu paulo deflexis armato; scapo valido bracteis magnis foliaceis triangularibus integris imbricato; paniculæ ramis robustis horizontalibus seu vix ascendentibus apice flores numerosissimos breviter pedicellatos ochroleucos gerentibus, ovario prismatico perigonium fere æquante, tubo brevi infundibuliformi lobis lineari-oblongis erecto-patulis duplo breviore, staminibus summo tubo adnatis longe exsertis, stylo sæpe demum stamina excedente; capsula ovata brevissime cuspidata, seminibus majusculis. — *A. Americana, β? latifolia*, Torr. Bot. Mex. Bound. p. 213, pro Emoryi planta; *A. Mescal*, C. Koch, Wochenschr. 1865, p. 94 (ex Jacobi), and *A. crenata*, Jacobi, Agav. p. 229, quoad plantam neo-mexicanam.

Western New Mexico to Northern Arizona, and perhaps eastward to the mountains below El Paso, apparently not south of the Gila River; flowers June and July. — The botanical history of this species is [312 (24)] similar to that of most of the larger Agaves, the material for whose definition must be gathered piecemeal and from many different sources. Oct. 19, 1846, a fruiting specimen was collected near the "Copper Mines" by Lieut. Emory, in the California expedition (see p. 310), l. c, p. 59, now preserved in the Torrey herbarium and mentioned in the Mex. Bound. Botany as a short and broad-leaved form of *A. Americana*. In 1865 Dr. E. Coues sent flowerbuds from Fort Whipple, which seem to belong to this species. In January, 1868, Dr. C. C. Parry, then on a railroad surveying expedition, again found it and collected seeds, which I distributed in Europe as *A. Parryi;* the young plants, raised from them, are now advertised in nursery catalogues, but no description has yet been published. Then Mr. F. Bischoff, of Lieut. Wheeler's expedition of 1871, brought capsules and seeds home. The first who, collecting foliage, flowers, and fruit, enabled me to connect all these scattered fragments, was Dr. J. T. Rothrock, Surgeon and Naturalist of Lieut. Wheeler's Southwestern Expedition of 1874. He met with the plant in "Rocky Cañon" and as far north as Camp Apache in Northeastern Arizona. Why Koch and Jacobi should have referred the short notes of Torrey to a plant which they found in cultivation in Europe, is unknown to me; Jacobi's description does in nowise agree with our plant, as the margin of the leaves is nearly straight and not "deeply crenate," etc.

Leaves erectish or the outer ones patulous, 10–12 inches long, 3–$3\frac{1}{2}$ inches wide, somewhat concave as all Agave leaves are, rather abruptly acuminate and terminating in a very robust spine, 1 inch long, flattened above, with two sharp lateral angles and a slight ridge in the middle; from this spine a horny, brown margin runs down the leaf-edges for 1 inch or more and to the uppermost teeth. Teeth 6–12 lines apart, comparatively small, only about $1\frac{1}{2}$ lines long, straight, or slightly curved up on upper, and smaller and curved back on lower part of leaf. Scape 8–12 feet high, 1–2 inches thick, bearing numerous large (2 inches wide at base, and twice as long, smaller upwards), triangular, closely adpressed bracts, herbaceous, with scarious brown margins and sharp points. Panicle itself, in well-developed plants, about 3 feet long, and 1 foot in diameter, the stouter branches considerably flattened, [313 (25)] $\frac{3}{4}$ inch wide, 6 inches long; ultimate pedicels usually 2–3 lines long. Flowers over 2 inches, the perigone 12–14 lines long, tube 4–$4\frac{1}{2}$ lines long and wide, lobe 9–$9\frac{1}{2}$ lines long and 2 wide; stamens inserted at the base of the lobes, the inferior a little lower than the exterior ones; filaments $1\frac{3}{4}$ inches, anthers 10 lines long; style often at last longer than stamens. Capsule wider in proportion to its length than in any other of our species belonging to this section, about $1\frac{3}{4}$ inches long and half as wide; seeds 4 lines wide, with flat, punctulate, strongly marked reticulation, visible under a strong glass.

12. Agave Antillarum, *Descourt. Flor. med. Antill.* 4 *tab.* 284 (1827): subcaulescens; foliis late lanceolato-linearibus elongatis, margine aculeis parvis distantibus rectis recurvisve fuscis armato, spina terminali valida fusca terete basi solum anguste canaliculata; scapo sub-10-pedali; paniculæ ovatæ ramis horizontalibus, pedicellis longiusculis dense fasciculatis; florum (aurantiacorum) ovario perigonio longiore, tubo late infundibiliformi lobis lineari-oblongis erecto-patulis ter quaterve breviore, staminibus basi loborum insertis longe exsertis; capsula ovato-prismatica cuspidata basi in stipitem brevem contracta.

San Domingo, Parry & Wright, U. S. Expl. Exp., Feb. 1871, in flower. — The unusual color of the flower and the native country of the plant make it almost certain that this is Descourtil's plant, and I adopt his, the oldest name, even if Grisebach's (Flor. West. Ind. p. 582) suggestion should prove true, that it might be identical with *A. sobolifera*, Salm, hort. 1834 (*A. vivipara*, Lam., non Linn.). This plant is also reported to come from San Domingo and

Jamaica, but to have greenish or yellowish-green flowers (Jacobi, Ag. 122) and to bear capsules as well as bulblets, whence the names; but none of our botanists seem to have observed such proliferation, which in other allied Agaves and in a Fourcroya were duly noticed. The measurements taken by them in San Domingo of a "medium specimen" are: height of leaf-bearing trunk 2 feet, length of leaf 30–36, greatest width 4½ inches; scape 8–10 feet high, at base 2½ inches thick, length of lower branches of the panicle 9, of middle 12, and upper 3 inches; nearly 100 flowers on the strongest branches.

A single leaf before me is 3 feet long and 3½ inches wide, the terminal spine 9 lines long, a narrow groove occupying only ¼ of its length; marginal teeth 6–12 lines apart, only 1 or at most 1½ lines long, [314 (26)] hard and sharp, deep brown. The flowers are reported as having a yellowish-green tube; limb and filaments and the anthers, before opening, are orange. The flowers before me belong to two forms, one with longer (1 inch) pedicels and larger flowers, the other with smaller flowers on shorter (3–5 lines) pedicels. The ovary of the former is 16–18, the tube 4, and the lobes 10–11 lines long; filaments not twice as long as lobes; anthers 11 lines long. The ovary of the smaller flower is 15, tube 2, lobes 7–8 lines long, and the exsert part of the filament longer than the whole perigone; in the former the stamens are inserted a little below the base of the lobes, in the latter at the very base itself. The capsule of the latter is 1½–1¾ inches long and 7–8 lines wide; seeds 3 lines wide.

* * Tubus perianthii lobis brevior vel æqualis; stamina medio tubo inserta.

† *Tubus lobis brevior.*

13. Agave Shawii, *n. sp.:* subacaulis; foliis perviridibus erecto-patulis supra basin dilatatam vix denticulatam paulo contractis ovatis acutis spina valida late excavata acuminatis, margine corneo fusco vix solubili aculeis subcontiguis maximis sursum curvatis vel varie flexis ornato; scapo valido bracteis foliaceis triangularibus toto imbricato; ramis paniculæ horizontalibus seu superioribus adscendentibus apice glomerulum florum subsessilium compactum foliaceo-involucratum gerentibus; ovario prismatico perigonio vix breviore, lobis lineari-oblongis suberectis tubo late infundibuliformi medio stamina paulo exserta gerente duplo longioribus, stylo stamina superante sæpius arcuato; capsula prismatica acuta.

On the arid hills which overlook the sandy strand of the Pacific in the southwest corner of California, where the boundary is marked by the initial monument, this fine species, growing together with *Cereus Emoryi*, was discovered by Dr. Parry in 1850, and a full description made; from his memoranda Messrs. Parker and Hitchcock of San Diego rediscovered it a few months ago and supplied me with most instructive photographs and excellent specimens; last summer Dr. Palmer collected it with immature fruit, and in November the above-named gentlemen found it in full bloom and sent fresh bunches to St. Louis. This is the short history of a remarkable species, [315 (27)] which will flourish, highly esteemed by amateurs as one of the most striking and beautiful Agaves, and commemorate, among all who love horticulture in other climes, the name of Henry Shaw, already so highly esteemed in St. Louis as the founder and donor of the "Missouri Botanical Gardens," grand at present, and promising a future as useful as it will be magnificent.

The trunk of this species is short and globose or more elongated, 8–12 inches long, but all covered with its very regularly (in $\frac{8}{13}$) arranged, broad, deep green leaves, forming masses nearly 2 feet in diameter, set off by the large bright red-brown spines. Leaves 8–10 inches long, 3½–4½ wide, with a distinct brown horny margin, which bears the unusually large, very close-set, flat spiny teeth, straight, or mostly curved up or rarely downwards, or flexuous, the largest (near the middle) 6 lines long and half as broad; in old leaves the margin with a few of the spines adhering is often partially detached, but not as regularly as e. g. in *A. heteracantha*. The stalk, 2–2½ inches thick, 8–12 feet high, is almost entirely covered with large (4–5 inches long by 2 wide) triangular bracts, foliaceous with brown scarious margins and tipped with a spine. The branches of the broad oval panicle are very stout (4–8 or 9 inches long, 1–1¼ thick) flattened above, and bear at the end a most compact cluster of 30–50 flowers surrounded by large foliaceous fleshy bracts, 1–2 inches wide, 2–3 long, which form a sort of involucre; the whole, after the flowers have fallen and only the short truncate closely-packed pedicels are seen, interspersed with subulate bracts, 1–2 inches in length, simulates the receptacle of some large Composita, 2–3 inches in diameter.

Flowers 3–3½ inches long, greenish-yellow; prismatic ovary 1¼–1½, perigone 1¾–2 inches long, tube outside 8–9, inside 6–7 lines long, lobes 12–14 lines long, outer a little longer and 3½, inner shorter, 4 lines wide. Stamens inserted in the middle of the tube, only about ½ inch longer than perigone; anthers 14 lines long; pollen grains oval, 0.09–0.12 mm. in longest diameter, beautifully marked. Style,[16] in the numerous specimens before me, curved and ½–¾ inch longer than the filaments, apparently already considerably lengthened when the stamens [316 (28)] begin to unfold. Capsules cuspidate but not stipitate, 2½–2¾ inches long, not quite 1 inch in diameter, forming a densely packed radiating cluster, 6 inches in diameter; seeds 4 lines wide.

[16] A triangular channel penetrates the style to near its base, where, by salient angles meeting in the centre, the cavity is divided into three tubes, which lead to the ovarian cells, somewhat obstructed, however, about the neck of the ovary by loose cellular tissue.

†† *Tubus lobis vix brevior vel æqualis.*

14. AGAVE RIGIDA, *Mill. Dict. ed.* 8, 1768 : caulescens; foliis lanceolato-linearibus glaucescentibus, margine aculeis distantibus rectis parvis fuscis dentato, spina terminali valida terete sæpe torta basi ipsa solum paulo excavata in marginem corneum decurrente ; scapo elato foliaceo-bracteato, paniculæ ovatæ capsuligeræ viviparæque ramis horizontalibus ramulosis fasciculos florum laxiores bracteis triangularibus brevibus stipatos gerentibus ; ovario perigonio paulo breviore, staminibus medio tubo infundibuliformi lobis paulo breviori vel supra medium insertis longe exsertis stylo demum æquilongis. — *Fourcroya rigida*, Haw. Syn. 74, Kunth en. 5, 843 ; *A. angustifolia*, Haw. Saxif. 35 ; *A. Ixtli*, Karw. ap. Salm, Hort. Dyck. 304; Jacobi Ag. 95.

Var. LONGIFOLIA : foliis multo longioribus glaucis, aculeato-dentatis, spina terminali non decurrente.

Var. ? SISALANA : foliis multo longioribus viridioribus margine integris seu pauci-dentatis, spina terminali non decurrente. — *Agave Sisalana*, Perrine, vide infra.

The original plant was, according to Miller, brought from Vera Cruz; my specimens, on which the above diagnosis is based, were collected in Yucatan by Dr. Schott. Dr. Perrine forty, and Dr. Schott ten years ago, studied in Yucatan this interesting plant, its different forms and economical uses, and left us accounts of it, the former in Senate Doc. 300, Washington, Mar. 12, 1838; the latter in the Report of the Agricultural Department at Washington for 1869. Both agree that there is a common native species in Yucatan, called *Chelem* by the aboriginal inhabitants ; but from time immemorial a number of varieties, all characterized by much longer leaves, and one also by the absence of marginal spines, and differing among themselves in the quantity and quality of their fibre, have been cultivated by the natives of Yucatan, and are a staple product of that country to this day, furnishing the well-known Sisal hemp. The people know them as *Jenequen* (Schott) or *Henequen* (Perrine), and distinguish, as [317 (29)] Dr. Schott reports, the *Yaxci* (Yashki) as furnishing the best quality and the *Sacci* (Sacqui) with the largest quantity of fibre ; *Chucumci*, larger than the last, produces coarser fibre ; *Babci* has fine fibre but in smaller quantity; *Citamci*, with small narrow leaves and poor fibre, stands probably nearest to the wild plant. Dr. Perrine mentions another variety, *Istle*, evidently the *Ixtli* of Karwinski, as furnishing a fine fibre called *Pita*. These plants yield a return of leaves when four or five years old, and may last 50 or 60 years under proper management ; the flowering scape is cut off as soon as 4 feet high, when, evidently, axillary branches continue the growth of the plant, which is thus kept so long alive by being prevented from flowering.

The trunk of the wild plant of Yucatan — which I refer with little doubt to Miller's old *A. rigida* — is 1–2 feet high, leaves 1½–2 feet long and as many inches wide, contracted above the broader base and widest about the middle ; lateral teeth ¾ or even 1 inch apart, mostly straight, from a broad base 1–2 lines long, rather unequal, with smaller ones interspersed, dark brown ; terminal spine 1 inch long, 1¾ lines in diameter, straight, or often somewhat twisted, terete, scooped out at base but not channelled, dark red-brown, a dark corneous margin extending down the leaf-edge for several inches and bearing the uppermost teeth. Scape 12–15 feet high ; flowers pale yellowish-green, 2¼–2½ inches long, perigone 16, tube 6–7, lobes 9–10 lines long ; stamens inserted about the middle of the tube, "blood-red upwards," 1 inch longer than the perigone ; anthers 10–10½ lines long ; styles at last as long as stamens.

A. Ixtli, which in 1872 flowered in the gardens of the late Mr. Thuret at Antibes, is entirely similar, flowers of the same dimensions, anthers a little larger (11½ lines long) ; capsules, which grow with the bulbs on the same panicle, oval, over 2 inches long, 1¼ wide, very short, stipitate ; seeds uncommonly large, 4½ lines high, with a ventral hilum (in many other Agaves I find the hilum more basal, a character which may be of some value). I believe this is the first time that the flowers of the Ixtli have been described ; they identify the plant with the old *A. rigida*, or at least the above-described Chelem. *A. Karwinskii*, Zucc. is probably the same thing.

With the name of *longifolia* I designate the variety known as *Sacci* and extensively cultivated in [318 (30)] Yucatan. It is principally distinguished by its much longer spiny leaves, 4–5½ feet long, 3½–4 inches wide; flowers very similar to those of the wild plant, but filaments greenish. *A. fourcroides*, Jacobi, Ag. 107, probably belongs here, and *A. elongata*, Jacobi, 108, I would also refer to this form if the description did not expressly mention a channelled terminal spine.

Agave Sisalana is the name that Dr. Perrine gave to the plant known to the natives of Yucatan as *Yaxci*, the most valuable of the fibre-producing Agaves, and which was introduced by him into South Florida, some thirty-five or forty years ago, during his efforts to acclimatize commercially valuable tropical plants in that almost tropical portion of our territory, — efforts which were aided by Congress by a large grant of land, but which were destroyed, together with his own life, during the subsequent Indian wars. With this Agave, however, he has been successful, as it is now fully naturalized, and is quite abundant at Key West and the adjacent coast. Dr. Parry found it there in full bloom in February, 1871, and gives the following description of it : trunk short, leaves pale green but not glaucous, 4–6 feet long and 4–6 inches wide, generally smooth-edged, but here and there bearing a few unequal, sometimes very stout and sharp teeth ; terminal spine stout, often twisted, purplish-black ; scape 20 or 25 feet high, panicle 8 feet long and half as wide; one of the largest plants examined had 35 branches in the panicle, the largest (near the middle) 2 feet long, upper and lower ones shorter. The flowers are slightly larger than those described, with a shorter, thicker ovary, stamens

inserted a little higher up in the tube. The plants bore no fruit, but produced an abundance of buds, by which they propagate themselves and from which this interesting form has been multiplied in this country and in Europe.

If this plant is, as is most probable, only a cultivated variety of *A. rigida*, it is of the greatest importance for the study and the understanding of the Agaves, indicating, as it does, the extent of variation which they may undergo. It shows that the size of leaf and scape and color of leaf, are of no great specific value; and also that the presence or absence of spiny teeth on the margin is not an unalterable character, not any more than the [319 (31)] cartilaginous margin decurrent from the terminal spine. The presence of a trunk, the proportions of the leaf (in *A. rigida* and all its varieties the length equals 12–14 times the width), probably the form of the terminal spine, the character of the inflorescence, and, above all, the form and proportions of the flower and its parts, remain constant, and perhaps also the proliferous character of the inflorescence of some species.

15. Agave Palmeri, *n. sp.:* acaulis; foliis lanceolatis sursum attenuatis in spinam gracilem teretem ultra medium canaliculatam excurrentibus, margine aculeis inæqualibus sæpius recurvis flexuosisve atro fuscis dentato; florum albidorum pedicellis bracteis abbreviatis carnosis fultis; ovario perigonio æquali seu paulo longiore, tubo lobis vix longiore stamina longe-exserta medio vel paulo supra gerente; capsula gracili prismatica brevi-cuspidata in stipitem contracta, seminibus minoribus minute verruculosis.

In the mountains of Southern Arizona Dr. Schott collected the flowers in 1855; in 1869, Dr. E. Palmer, who during ten years has made Arizona and the adjacent regions the field of his explorations, and for whose services to botany in that district this species is named, gathered more complete specimens and seeds; and last year, 1874, Dr. Rothrock, of Lieut. Wheeler's expedition, brought very fine specimens found there at an altitude of 6,300 feet. — Flowers July and August.

This species seems to take in the southern part of Arizona the place of *A. Parryi* of the northern part of that territory, and is used there for the same purpose; it is easily distinguished from it by its longer and narrower leaves, the much less deeply divided perigone, and the slender capsule and small seeds. — Leaves 10–20 inches long, 2–2½ wide, slightly contracted above the base, long pointed; terminal spine 8–14 lines long, deeply channelled to above the middle, decurrent with brown, horny margins about 2 inches; lateral teeth ½–¾ inch apart, 1½–2 lines long, often interspersed with smaller ones, straight, or usually hooked, or often, especially the lower ones, flexuous. Scape 8–12 feet high (bracts not noticed by the collectors); branches of the panicle repeatedly and loosely ramified, ultimate pedicels crowded, about 1 line long. Flowers 1¾–2 inches long; perigone 10–12 lines long, whitish; filaments, anthers, and style, purple; lobes usually a little shorter than the tube, exterior ones strongly cucullate and much thickened at the apex, interior shorter, broader and thinner; nectariferous part of tube, below the [320 (32)] insertion of the stamens 2½–3 lines long, a little longer than upper part of tube; exsert part of filaments about the length of perigone, anthers 8 lines long; capsules slender, 18–24 lines long, 7–8 wide; seeds among the smallest of this section 2½ lines in the longest diameter, easily distinguished by the minute tubercles, 0.01 line wide, which, different from other Agave seeds, cover the surface.

16. Agave Wislizeni: acaulis; foliis ovatis supra basin paulo angustatis medio latissimis acutis, spinæ subflexuosæ supra late exaratæ margine acutiusculo decurrente, dentibus rigidis atrofuscis superioribus majoribus distantibus rectis, inferioribus parvis confertis subdeflexis; panicula laxiflora; ovario perigonium et tubo lobos fere æquante, staminibus ultra medium tubo adnatis longe exsertis; capsula gracili prismatica utrumque acuta nec stipitata, areolis seminum planis punctulatis. — *A. scabra*, Salm, Bonpl. 7, 89; Jacobi, Ag. 88.

This interesting species was discovered by Dr. A. Wislizenus on the celebrated march of Doniphan's corps through Northern Mexico, on the Nazas River near San Sebastiano, in the southeast corner of the State of Chihuahua, not far east of Parras, May 10, 1847, in flower and fruit. Living shoots were sent by me to Prince Salm and seeds to different European correspondents, among others to Prof. A. Braun of Freiburg. Two years later Gen. v. Jacobi obtained some of the young plants raised from these seeds in the botanic garden of that university and afterwards communicated them to Prince Salm, who described them (1858) under the inappropriate name *A. scabra*, though, as the General expressly states, they are perfectly smooth on both sides.[17] As thus the published name is inadmissible, I deem it proper to substitute for it that of the discoverer of this and so many other interesting plants of Northern Mexico.

Jacobi describes his specimens (then 16 years old, and, as he thinks, full grown) as 8 inches high and 15 in diameter, rosulate and somewhat squarrose, with broad, nearly rhombic and almost flat leaves, 5 inches long, 3½ wide, pale grayish-green, teeth distant and curved downwards. The leaf of the wild plant, now [321 (33)] before me, is 8 inches long and 4 wide, terminal spine very stout, 10–11 lines long, decurrent about the same distance; arrangement of marginal teeth quite peculiar, the uppermost ones the largest, 1½–2½ lines long from a

[17] *Agave asperrima*, Jacobi, is one of the few rough ones, and the only hairy one known, I believe, is *A. pubescens*, lately described by Regel. This species, obtained from Mexico and flowered at St. Petersburg, is one of the smaller ones and seems to belong to the first section.

broader base, straight, almost black and very rigid, 6–8 lines apart; teeth below the upper third smaller and closer set, and below the middle only 2–3 lines apart, less than 1 or only ½ line long and strongly curved downwards. Scape 12 feet high, branches of the panicle loosely ramified, branchlets 3–6 inches long, pedicels 1–2 lines long; flowers in small clusters, 3–6 or 8 together, 2½ inches long, perigone half as long, divided to the middle; stamens inserted about ⅔ from the base of tube, exsert about ¾ inch above lobes; anthers 10–10½ lines long. Capsule 18–22 lines long, 7–8 wide, similar to that of last species but not stipitate; seeds 2¾ lines in diameter, cells of the surface under the microscope, flat, punctulate.

I have a flower and a capsule of Agaves differing from any above described, and thus perhaps indicating two other species; but as the material is too incomplete to characterize them, I only indicate them here for further investigation,

AGAVE SP. "Common on mountain sides in the Wild Rose Pass on the Limpio," West Texas, Chas. Wright, No. 1906; flowers only, collected June 11, 1851, referred by Torrey in Bot. Bound. 213, to *A. Americana*. Flower not quite 3 inches long, perigone equal to ovary, divided to the middle; stamens inserted about ⅔ up the funnel-shaped tube, reaching 14 lines above the lobes; anthers 10 lines long. — Could it belong to the last described species, which was found 300 miles further south?

AGAVE SP. Dragoon Mountains, Southeastern Arizona, Capt. Chas. Bendire, U. S. A. A capsule and seeds only, with the verbal information that the leaves are about 3 feet long and 4 inches wide, and the scape nearly 20 feet high. The capsule is ovate-prismatic, 2 inches long, 10 lines wide, strongly cuspidate, at base obtuse; seeds 3½ lines in longest diameter, apparently minutely pitted. — It is not probable that this could be a form of *A. Americana*, as that species has, I believe, always a stipitate capsule and larger seeds with flat, punctulate areæ.

ADDITIONAL REMARKS.

The highest trunks of cultivated Agaves which I find noticed are 3–4 feet high, and [322 (34)] 3–4 inches in diameter; the thickest one was 14 inches through, but less high. I have met with no account of the size they may attain in their native country.

The scape of *A. Americana* is said to measure sometimes 36 feet in height.

The flowers of Agave are always more or less erect and of a coarser, calycine texture, while those of Yucca are pendulous and corolline.

NOTICE TO BOTANISTS.

I wish to direct the attention of botanists, who have the opportunity to observe the development of these plants, to the following questions: —

At what hour of the day do the anthers of the different species burst and begin to shed their pollen, when do they become entirely effete, and in what state is then the style? How long afterwards and when does the style of the same flower attain its full development, and when and how much do the stigmatic lobes open or spread, and when does the stigmatic liquid fill the cavity of the style and cover the inside of the lobes? — I have above given an account of these physiological processes in *A. Virginica*; the only reference to them in literature which I can find is made by Jacobi, Ag. 310, where he says of an Agave of the second section, that the full development of the style and the separation and partial spreading of its lobes take place only after the stamens have faded, which, as far as it goes, fully coincides with my observations. His further remark, that the stamens are not inflexed in the buds of that species (*A. Gœppertiana*), is unquestionably erroneous. Of the floral development of the Agaves of the third section nothing at all seems to be known.

I wish also to direct the attention of observers to the time and nature of the secretion of honey in the lower part of the flower-tube.

The inflorescence of those Agaves of the second section which are said to bear 1 or 3 or 6 to 8 flowers in a fascicle requires further investigation.

A careful examin- [323 (35)] ation of the young (forming) inflorescences of the third section will disclose the true nature of their arrangement.

Another point which claims the attention of observers, is the place and time of the formation of bulblets in the proliferous Agaves.

PLATE 2.

ADDITION TO ARTICLE ON AGAVE.

l. c. 1876, pp. 370–1; pp. i.–ii. OF REPRINT.

Additions and correc- [i] tions have accumulated in the interval between printing and publication.

Page 294. It requires further and extensive observations in the field and in the garden to ascertain the limits of variability of the edges of the leaf and its aculeate-toothed margins. Cultivators have already discovered considerable latitude in this respect in plants raised from seeds from the same parent.

Page 302. Var. *tigrina* does not grow *in* salt-marshes, but was found by Dr. Mellichamp, "in one spot only, on a tongue of partly brackish land, extending out into the salt-mud and marsh, under dwarfed live-oaks, Cassine, and saw-palmetto, on the decayed shells, mixed with sand and earth, of what seems to be an old Indian oyster-heap"!

Page 304. *A. falcata*. The lately introduced *A. Hystrix* of the Belgian nurseries may have to be referred to this species; native country and flowers, as usual, unknown.

Page 305. *A. Schottii* (better than *Schotti*, as printed). It is proper to add that *A. geminiflora*, Gawl., the *Bonapartea juncea* of the gardens, is a very different plant, and has nothing to do with *Schottii*, except that both belong to the same section of the genus.

Page 310. *A. deserti.* In characterizing the foliage, I was led into the too common mistake of adopting the individual characters of a single individual as those of the species. Full grown leaves are at least 15–20 inches long, and 2–3 inches wide above the base. The terminal spine is compressed and narrow-grooved only in the young, not fully developed leaf; in the adult it is terete-triangular with a wide and shallow excavation above. — The locality is Vallecito, not "Valcitron."

Page 314. *A. Shawii.* To the liberality of Mr. Henry Shaw we are indebted for the fine photographs of this species which grace this number of our Transactions.* They were taken by Mr. J. C. Parker of San [ii] Diego, last January. Plate 2 represents a group of these plants on the *mesa* near the coast of the Pacific, which is seen in the distance; one specimen is in full bloom, others flowered in November and are now bearing fruit sparingly. Decaying old plants are seen around, and young ones sprouting. The phyllotactic arrangement of the short broad leaves is beautifully displayed; the bright spiny teeth appear almost white from the effect of reflected light. The scape is conspicuously covered by the broad, triangular, imbricated bracts. The figures are about one-twenty-fourth of the natural size, or half an inch to the foot.

Fig. 1.

Fig. 2.

PLATE 3.

Plate 3 shows, in Fig. 1, a young plant; its leaves are more deeply concave than they are later, and therefore seem to be narrower; the teeth and their impressions on the adjoining leaves are remarkably well developed. One-fourth of natural size. — Fig. 2 is a cluster of flowers, exhibiting a densely compacted mass, unfortunately not distinct enough in its details; but the outlines of the cluster, the enveloping bracts, the very long, mostly vertical, anthers, and the exserted styles, are well rendered. It is two and a half times less than the natural size.

Page 322, line 1. In the Berlin botanic garden an *Agave attenuata* is cultivated which has a trunk 6 feet high; it is said to have grown 4 feet within the last 18 years.

* These photographs are reproduced, as well as possible, by the Ives process, on this and the preceding page. — EDS.

VI. THE FLOWERING OF AGAVE SHAWII.

From the Transactions of the Academy of Science, of St. Louis, 1877, Vol. III. pp. 579–582; pp. 1–4 of reprint.

In May, 1876, Mr. Shaw received from San Diego, Cal., through the kind offices of Messrs. Hitchcock and Parker, a full-grown specimen of the fine species named for him. In June the new, innermost, leaves became more slender and their marginal teeth smaller. Early in July the flowering stalk began to rise. Regular measurements of its growth were made by Mr. Gurney, the superintending gardener, at 7 o'clock A. M. and at 7 P. M., from July 8th to September 5th. I have divided this period of 60 days into 6 decades, and have added the mean temperature and the fall of rain (at my station, 3 miles northeast of the garden) of each decade. The following table exhibits these data: —

Amount of Growth in Ten Days.

1876.	7 P.M.–7 A.M.	7 A.M.–7 P.M.	Total.	Mean Temp.	Rainfall.
July 8–17	2¾ in.	2 in.	4¾ in.	82°.8	1.26 in.
" 18–27	3 "	2¼ "	5¼ "	77°.4	1.03 "
" 28–Aug. 6.	4¾ "	3¾ "	8½ "	69°.1	0.72 "
Aug. 7–16	7 "	4½ "	11½ "	78°.3	1.51 "
" 17–26	5 "	4 "	9 "	79°.1	2.21 "
" 27–Sept. 5.	4¾ "	3 "	7¾ "	72°.6	1.71 "
July 8–Sept. 5.	27¼ in.	19½ in.	46¾ in.		

The table shows that the night-growth (including the morning hours) was in every decade larger than the day-growth, and in the whole period surpassed it by 16 per cent., the former amounting to 58, the latter to 42 per cent.

It is further seen that the largest advance was made about the middle period, or from the 3rd to the 5th, and mostly in the 4th decade. After Sept. 5th the growth diminished rapidly, about the end of the month the head began to swell, and 3 months later the first blossoms opened.

The table also proves that the temperature of each decade did not have any material effect on the growth of the stalk; in the warm weather of the first two decades it grew much less than in the cooler 3rd period.

The largest growth in 24 hours, 1½ inches, took place in the 4th decade, Aug. [580 (2)] 10th–11th, mean temp. 78°; while on Aug. 18th, with mean temp. 84°, the growth is marked only ½ inch, and Aug. 23rd and 25th, mean temp. 85°, it amounted to 1 inch and ¾ inch respectively.

The quantity of rain had apparently little or no immediate effect, as it was pretty evenly distributed through the whole period.

The full-grown scape measured 54 inches to the base of the panicle, which, when fully developed, was itself 21 inches long and a little wider, and consisted of 19 branches, the lowest ones the longest, somewhat S-shaped, and horizontal, with the end turned up.

About Newyears the lower branches of the panicle, which thus far had formed a pointed club covered by the large bracts, began to straighten out, while the upper ones with their bracts yet formed a large cone. The first flowers opened on the lowest branch on Feb. 5th; the innermost ones of each cluster developed first, the others flowering in quick succession, so that all the flowers of a bunch were in bloom within about three days. Two or three weeks later the plant may be said to have been in fullest bloom, though the lower clusters were passed and the uppermost not yet open. These last flowered about March 18–20th, so that the flowering period (at this season and in a greenhouse) occupied from six to seven weeks.

Abundant opportunity was afforded to study the gradual development of the flowers (see also p. 298). I have, on Plate IV., represented these various phases by a series of figures carefully drawn from nature.

The bud bursts in the morning or in the middle of the day (Fig. 4); the bent filaments begin to straighten out, the still closed anthers commence to protrude, the top of the style has not yet reached the tip of the perigonial lobes. Only thus far the perigone and its lobes are fresh, exhibiting their fullest development.

In the evening of the same day the filaments are straightened out above the perigone, the anthers begin to open at the upper and lower ends, as Fig. 6 shows, and then all along their commissures; the style has not yet reached the length of the filaments, but the perigonial lobes are already withering at tip.

On the 2nd day the anthers are shrivelled, though quantities of pollen remain adher- [581 (3)]
ing to them; the perigone withers more; the style in the morning is still shorter than the filaments, but in the evening has exceeded their length somewhat; the stigmatic lobes remain entirely closed.

On the 3rd day these changes go on gradually and slowly. (Fig. 7.)

On the 4th the style is 2 inches longer than the perigone, the lobes of which are wilted and twisted, while the filaments also wither; in the evening the stigmatic lobes begin to separate and exude some moisture. The color of the flower, which at first was greenish and sulphur-yellow, now is of a deeper dirty yellow.

On the 5th day the style has reached its full development, $2\frac{1}{4}$–$2\frac{3}{4}$ inches longer than the wilted perigone; the filaments are drooping, the anthers shrivelled, much pollen yet adhering to them; the stigmatic lobes have separated and are covered with a large drop of sweet, glutinous stigmatic liquid, which causes the pollen grains that drop into it to develop their long tubes (Fig. 8).

The drop of stigmatic fluid remains fresh and full for another and often even a third day, and then gradually dries up; the functions of the flower are ended with the fertilization of the ovules.[1]

I have not yet made mention of the abundant secretion from the nectariferous lower part (all the part below the insertion of the stamens) of the perigonial tube. During the several days in which the flowers were open the whole tube was filled to the brim with a sweetish watery liquid, of a slightly nauseous odor. I am not aware that such a secretion has before been observed in Agave flowers, and would now consider it as an abnormal phenomenon, originating under artificial circumstances, had not others, whose attention I had directed to such secretion, noticed the same in other species. Prof. C. S. Sargent, of Cambridge, Mass., saw it in an *A. yuccæfolia* which bloomed there last winter under glass, but could not find it in two specimens of the same species which in September flowered in the open air. Of greater importance, because made on a wild plant on its native mountains, is the observation of the Rev. E. L. Greene, who found last summer [582 (4)]
in Southwestern New Mexico the large paniculate *Agave Parryi* so loaded with this liquid that it actually rained on him when he knocked on the stalk, or when the wind shook the panicle. South European botanists, who have numerous cultivated species and especially the naturalized *A. Americana* at their disposal, are in a position to investigate and experiment upon this curious physiological fact. Our *A. Virginica* exudes only a small quantity of honey in the base of the tube, but nothing like such a watery abundance.

[1] Buds or flowers that are kept for a while separated from the plant, such e.g. as are sent fresh by mail, become distorted, the ovary swells, the style lengthens, but the perigone and stamens wither even if not yet fully developed.

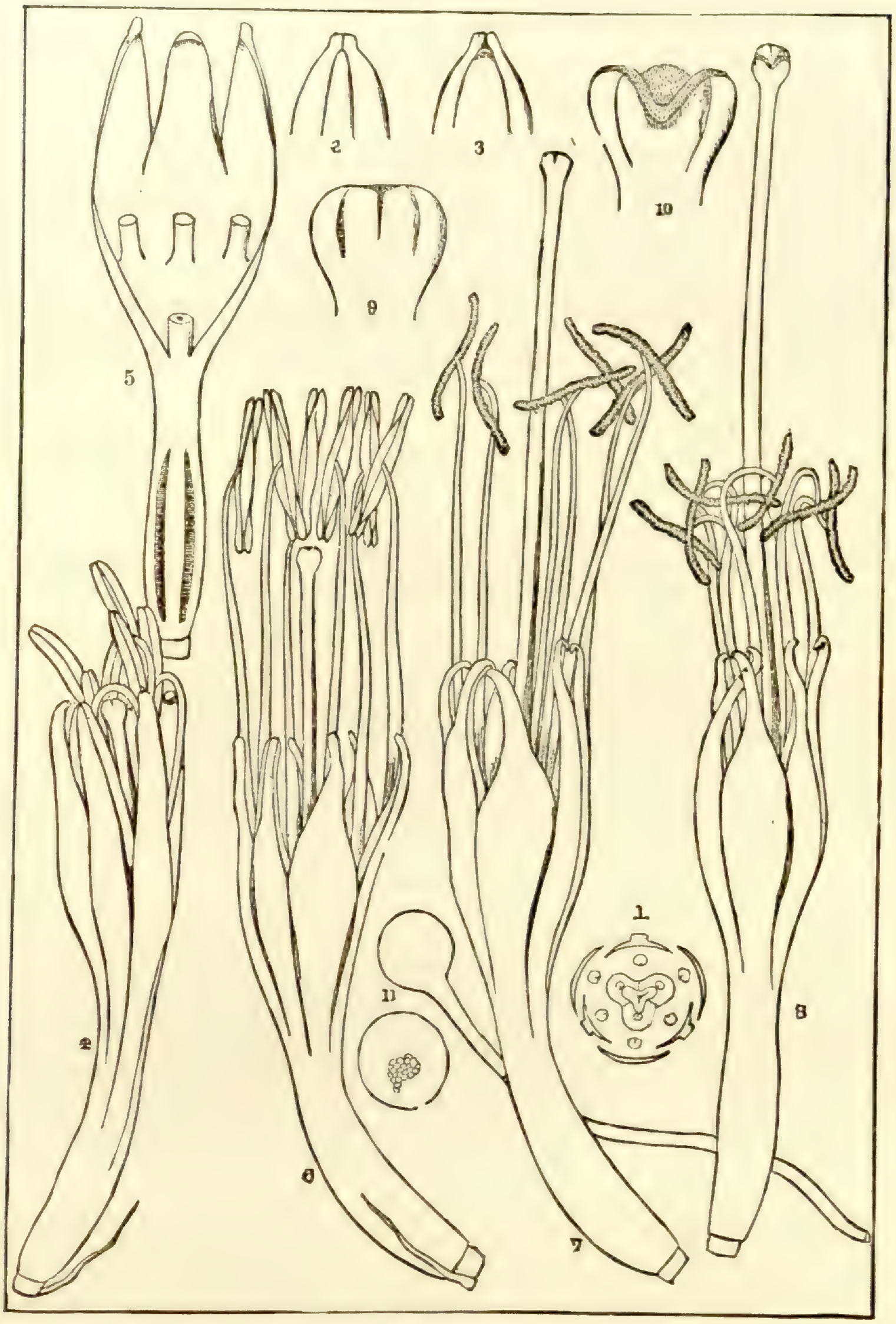

PLATE IV. AGAVE SHAWII.

EXPLANATION OF PLATE IV.

Fig. 1. Diagram of the flower. Three exterior lobes of the perigone cover the thin margins of the 3 interior ones; 6 stamens opposed to the lobes; 3 carpels opposed to the three exterior lobes, each with two series of ovules; in the centre the stigma, its 3 lobes alternating with the carpels.

Fig. 2. Top of the flower-bud, showing one interior between two exterior lobes.

Fig. 3. The same, inside, exhibiting the broader hood of the inner lobe between the longer and narrower outer ones, all of them downy below the tip.

Fig. 4. An opening bud in the forenoon of the first day; the filaments begin to straighten, raising the anthers, apparently in irregular order, above the perigone; style quite short.

Fig. 5. Section of the same, with style and filaments cut off; the perigone is seen in full development before it begins to wither; insertion of the filaments in the middle of the tube, the inner one slightly lower than the outer ones.

Fig. 6. Flower fully open on the first evening; filaments straight; anthers opening at the upper and lower end; style not yet of the length of the filaments.

Fig. 7. Flower on the third day: anthers and perigone shrivelling; filaments yet erect; style of nearly full length; stigma yet closed.

Fig. 8. Flower on the fifth day: perigone and filaments wilted; style fully developed; stigmatic lobes separated and bearing a large drop of glutinous liquor. — All these figures in natural size.

Fig. 9. Stigma closed.

Fig. 10. Same with expanded lobes, both magnified 4 times.

Fig. 11. Pollen grains magnified 100 times: one intact, slightly elliptic; the other, developing its tube and somewhat contracted.

VII. AMARYLLIDEÆ OF WHEELER'S EXPEDITION.

From Report, etc. Vol. VI. Botany. By J. T. Rothrock. 1878.

Agave Utahensis, *Engelm.*, Bot. King's Report, 497; Engelm. Agav. in Trans. Acad. St. Louis, 3, 308. — [267] Stemless; leaves suberect, or outer ones spreading, lanceolate, tapering from a broad base, concave, 6–12 inches long, 1–2 inches wide, not constricted above the base, very thick, hard, glaucous and rough, terminating in a long (1 inch) pale spine, with broad whitish teeth on the margin; flowering stalk 5–7 feet high, with a spike-like raceme of yellow flowers each 1 inch long, in pairs, or often in clusters of 4, on distinct pedicels; lobes 3 times longer than the funnel-shaped tube, which bears the stamens in the middle; filaments and style not much longer than the perigone; capsule oval subcylindric, about 1 inch long. — Northern Arizona, Bischoff, to Southern Utah.

Agave Parryi, *Engelm.*, Agave, l. c. 311. (*A. Americana*, var. *? latifolia*, Torr. Bot. Mex. Bound. 213.)— Stemless; numerous short and broad (9–12 inches long and 3–3½ inches wide) leaves crowded around the base of the stalk pale, glaucous, with small, almost black, spiny straightish teeth, and with a dark horny margin toward the cuspidate tip, which terminates in a robust, somewhat triangular, black spine 1 inch in length; stout scape 8–12 feet high, bearing a large branched panicle of cream-colored flowers over 2 inches in length; perigone deeply 6-parted; lobes twice as long as tube, which bears the long-exsert stamens in its throat; capsule broadly oval, sessile; seeds larger than in either of the other species. Western New Mexico and Northern Arizona; Rocky Cañon, Rothrock [268] (274) in 1874. Parry, Bischoff, only fruit. Dr. Rothrock's observations and very complete specimens enabled me to give a connected account of this species, of which fragments only had been known for many years. Rev. Mr. Greene noticed the abundant secretion of a sweetish liquid filling the tube, which has also been observed in other species. The rootstock is used as a substitute for soap by the natives, under the name of Amole, much like that of Yucca, and when roasted, is considered a great delicacy, named Mezcal.

Agave Palmeri, *Engelm*, Agave, l. c. 319. — Stemless; leaves lanceolate, 10–20 inches long by 2–2½ inches wide, attenuate into a slender, terete, narrowly channelled, brown spine; marginal teeth flexuous or recurved, dark brown; scape as in the last; panicle loosely branched; flowers 2 inches long; perigone whitish, lobes a little shorter than tube, stamens from its middle, and, together with anthers and style, long exsert, purplish; capsule cylindric, stipitate; seeds small, roughish. Camp Bowie, Arizona, Rothrock (496), 1874; Palmer, in Southern Arizona. Similar to the last, but readily distinguished by its longer, narrower leaves and the other characters enumerated. Used for the same purposes as the last.

VIII. COLLECTED DESCRIPTIONS OF AGAVE.

From Torrey's Botany of the Boundary (in Report on the United States and Mexican Boundary Survey, etc., Washington, 1859).

Agave maculata, *Engelm.:* radice crassa cylindrica nigra ; foliis radicalibus lanceolato-linearibus longe acu- [214]
minatis subtus convexis supra profunde concavis recurvatis glaucis maculis atro-virentibus notatis, margine albido cartilagineo-dentatis apice acutis nec spinescentibus ; scapo basi foliis paucis instructo ; floribus in spicam simplicem dispositis brevissime pedicellatis ; tubo corollæ superne vix ampliato, laciniis lineari-oblongis rotato-patentibus. — Eagle Pass on the Rio Grande. Root 6–8 lines in diameter, 4–6 inches long ; black, with long thick white [215]
fibres. Leaves 4–6 inches long, ½ an inch wide, deeply channelled, but not carinate, very glaucous, the dark greenish-brown blotches more distinct on the upper than the lower surface. Scape 1½–2 feet high. Spike about 6 inches long, with 12–15 flowers. Bracts subulate, longer than the pedicel, which is about one line long and articulated in the middle. The flowers, which are of musky not disagreeable odor, are about 20‴ long ; ovary 6‴, tube 9‴, the limb about 6‴. Laciniæ of the perianth at first green, afterwards on both sides (with the filaments) of a dirty purplish color. Evidently near *A. revoluta*, Klotzsch ; but that species has smooth-margined leaves ; limb of the perianth equal to the tube ; stamens free in the tube, and longer than the limb. To *Polyanthes Mexicana*, Zucc. (which Kunth in Enum. 5, p. 847, says is probably a species of Agave) it is still more nearly related, but that has leaves entire on the margin, with reddish dots ; flowers white, in pairs and sessile, the tube 18 lines long, segments only 3–4 lines long. Capsule (immature) ovate-oblong obtusely triangular. Nothing is said of the fragrance of the flowers.

From Report on Clarence King's Exploration of the Fortieth Parallel. Vol. V. Botany. By Sereno Watson. 1871.

Agave Utahensis, *Engelm., n. sp.* Leaves basal, stout, very fleshy, tapering from a broad base and ter- [497]
minating in a long channelled spine, herbaceous on the sinuate margins between the horny flat teeth ; scape bearing a dense spike of small yellowish flowers in fours or pairs ; the oblong obtuse erect lobes of the perigone as long as the ovary, 3–4 times the length of the short campanulate tube ; stamens from the middle of the tube, together with the style slightly exsert ; anthers of the length of the lobes ; capsule cylindric-ovate, acute. — About St. George, Utah (Dr. E. Palmer, J. E. Johnson). Leaves at base 1½–2 inches wide, 5 inches long, with stout broad white straight or rarely recurved spines on the margin ; terminal spine whitish, nearly 1 inch long ; each leaf marked with the impressions of the teeth of those next to it ; scape 5–6 feet high ; flowers, ovary included, about 1 inch long, tube very shallow, scarcely more than 1 line long ; capsule and seeds among the smallest in the genus, the former 9–10 lines long, the latter 1¼–2 lines in longest diameter. Allied with *A. heteracantha*, Zucc. (*A. Poselgeri*, Salm., *A. Lecheguilla*, Torr.), which extends from Mexico into New Mexico and Arizona.

From the Gardeners' Chronicle.

Agave Parryi (Fig. 39). — We have had here [St. Louis] in May, Agave Parryi in bloom. The speci- [237]
men was sent to Mr. Shaw's garden from Arizona a year ago, and developed its flowering-stalk during winter. I enclose to you a photograph, and if you think it worth while to reproduce it in the *Gardeners' Chronicle*, I would direct your attention to the very long exsert styles, which in the photograph are very indistinct. It was interesting to find most of the flower-bunches open at the same time, presenting with their (at a distance) deep yellow flowers quite a gorgeous appearance. The stalk is about 8 feet high, 7 inches in circumference at base, the panicle is 2¼ feet high, and 1 foot in diameter, and consists of about sixteen branches. The leaves are well characterized by the semiterete or somewhat triangular terminal spine, nearly flat, or slightly keeled above. They are about 10 inches long, and 3 inches wide. — [Aug. 23, 1879, n. s., vol. xii.]

Agave (Littæa) Victoriæ-Reginæ, *T. Moore.* Acaulescent ; leaves 100 to 250 in a compact rosette, [788]
ovate-lanceolate, concave, 6–8 inches long, 2–2½ inches wide above the slightly dilated base, ½ to (towards the base) 1 inch thick, rigid, dull green, with white markings, and a horny, entire, at last detached border, which terminates in a rigid, often twisted, blackish spine, usually bearing a few teeth at its base, often with a similar horny border on the dorsal keel, similarly terminating in one or two teeth at the base of the terminal spine (which thus appears two- or three-crested) ; scape, 8–10 feet high, 1 inch thick ; flowering-spike about one-third of its length, very dense, bearing in the axil of each bract three short-pedicelled flowers ; flowers [with the stamens] about 2 inches long ; ovary over ½ inch ; tube broadly funnel-shaped, only ½ line long, perigonial lobes oblong-linear, 8 lines long ; filaments inserted at the base of the lobes, more than twice as long as these, and rather exceeding the style, which bears three orbicular, at last spreading, stigmas ; capsule about 9 lines long, oblong, cuspidate ; seeds, 2 lines long. — *Gard. Chron.* n. s., iv. p. 485, with woodcut (fig. 137) ; *Flore des Serres*, xxi. p. 169, with woodcut, Baker, in *Gard. Chron.*, vii. p. 528. — *A. Consideranti*, Carrière, in *Rev. Hort.* 1875, p. 429, fig. 68.

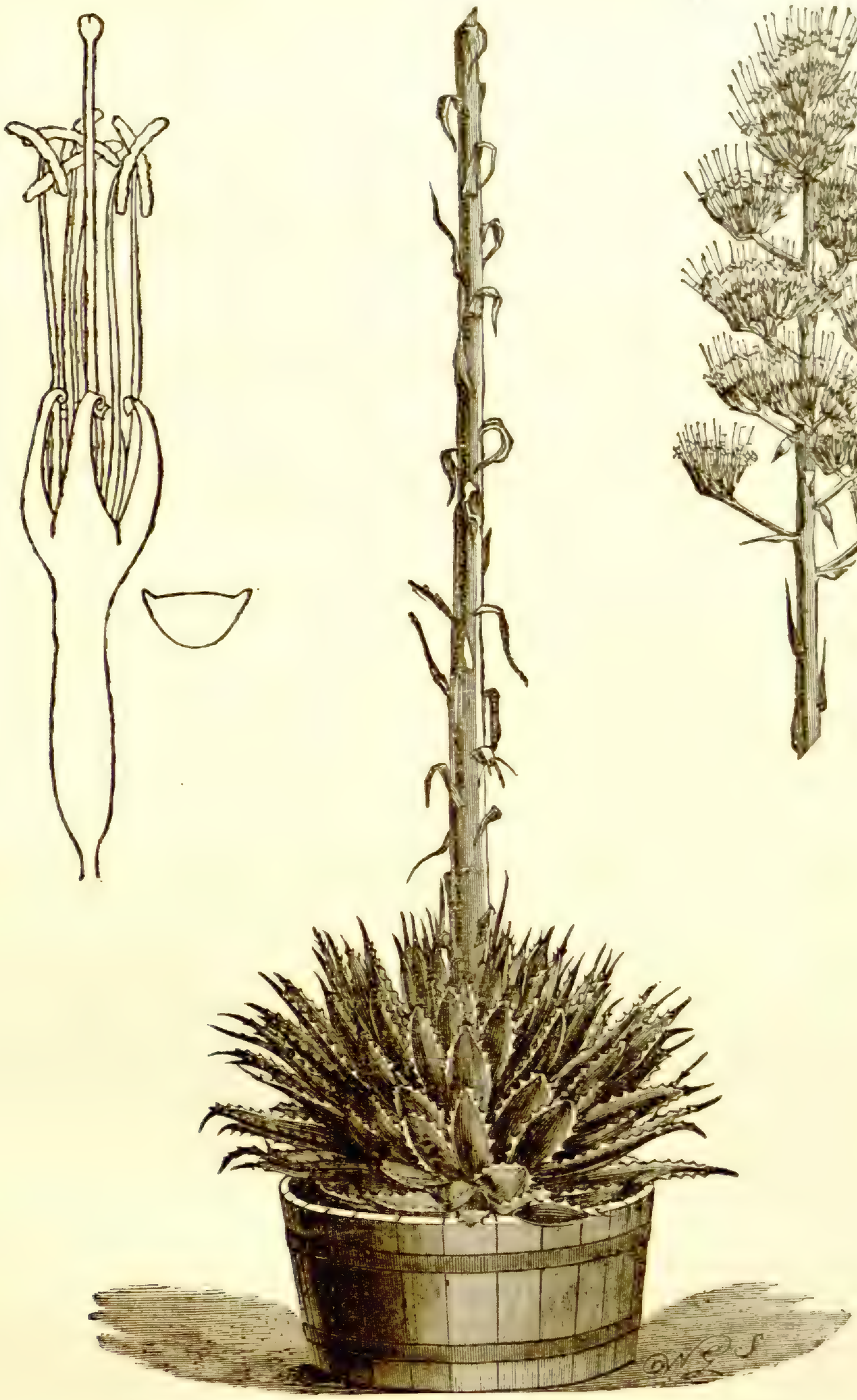

FIG. 39. — AGAVE PARRYI.

In coarse gravelly soil on steep hills near Monterey, Northern Mexico, flowering in autumn, according to Dr. E. Palmer, who gathered fruiting specimens in February last. The largest plant which he sent to St. Louis has a diameter of 2 feet, a height of 14 inches, and bears about 250 leaves, 7 to 8 inches long and 2 to 2½ wide. The leaves of the older plants bear white streaks, which seem to correspond with and are probably produced by the pressure of the adjoining leaves, but other wavy, transverse marks on the leaves of younger plants can scarcely thus be accounted for. The inflorescence is that of a very dense-flowering Littæa, the flowers with an extremely short perigonial tube. The great morphological interest consists in the regularly (at least in my specimen) tri-flowered bunches, the third flower occupying the centre between the two normal twin flowers of this section ; this is probably the primary flower, which in most or in all other Littæas is entirely absent, or is in a few species only indicated and represented by a bristle. Where I have seen more than two flowers in a Littæa (*e.g.* often in *A. Utahensis*), the third and fourth flowers are axillary to the bracts of the first and second one. — [June 19, 1880, n. s., vol. xiii.]

AGAVE VICTORIÆ REGINÆ. — This species flowered in the Botanic Garden of Cambridge (U. S.) in the [841] latter part of August and beginning of September of this year (see fig. 149, p. 845)[1]. The specimen was obtained by Dr. E. Palmer, near Monterey, Mexico, in February, 1880. It forms a regular compact cone of over 200 conniving leaves; the stalk, about 2 inches thick at base, was over 10 feet high, and about 6 feet of it consisted of the very dense flowering spike, while the lower part of the scape was covered with numerous bracts, linear-subulate, from a broad base, the lower ones 4–5 inches long, and spiny-pointed, each one bearing in its axil 3 small knobs, evidently abortive flower-buds. The flowers, with all their parts pale greenish-yellow, were densely crowded, and very regularly and constantly arranged in threes, just as the capsules were in the native specimen described in this journal, June 19, 1880 (p. 788). The flowers are 1¼ inch and not 2 inches long, as was misstated in the former article, the ovary about ½ inch, the perigone ¾ inch, its tube being only 1½ line long; stamens inserted about the middle of the tube, and exserted beyond the perigone about 1¼ inch; anthers ½ inch long; tube filled with nectar to the brim. The stigmatic lobes in most cases never opened, and thus no fertilization took place, except in some flowers near the top of the spike. Young plants raised from seeds in the spring of 1880 begin only now, after more than two years, to show the character of the species. Until now the leaves were unspotted, their edge slightly denticulate, and the terminal spine simple. The cut (fig. 149, p. 845),* is from a photograph sent by Dr. A. Gray. — [Dec. 30, 1882, n. s., vol. xviii.]

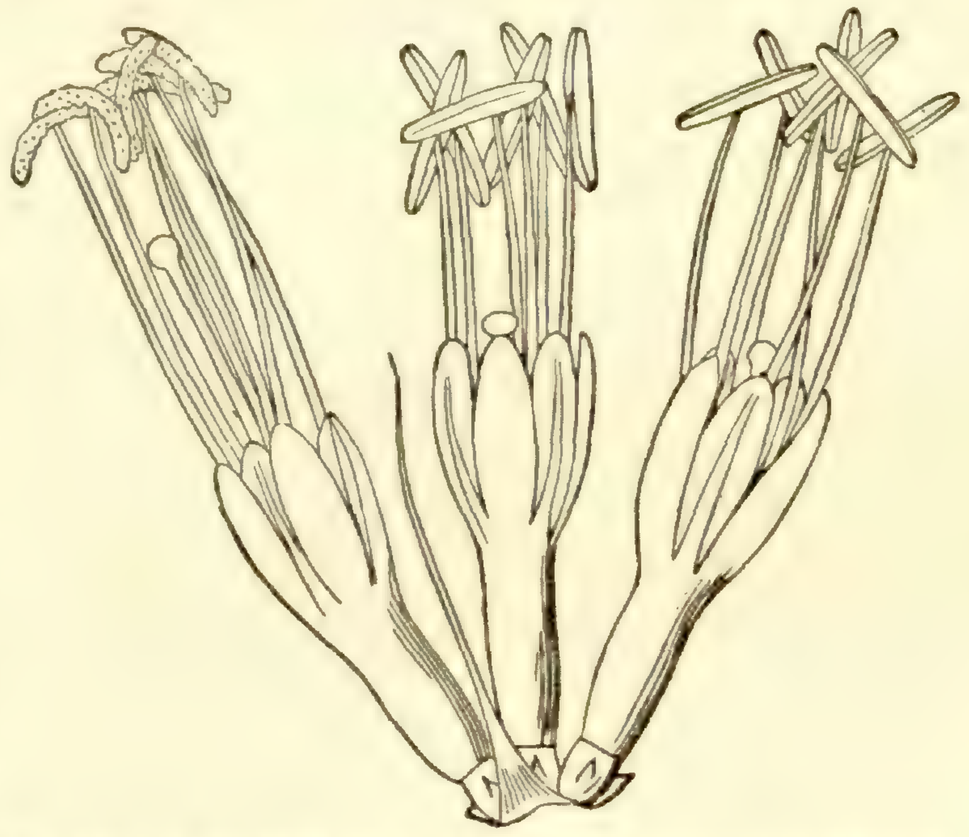

FIG. 148. — FLOWERS OF AGAVE REGINÆ : GREENISH-YELLOW.

AGAVE BRACTEOSA, *S. Watson in Herb.* (See figs. 138, 139.) Acaulescent, with 10–15 lanceolate or broadly [776] linear, fleshy, grayish-green, irregularly spreading leaves recurved at the tip, 18–22 inches long, tapering from a width of 1½ inch near the base gradually to an herbaceous point without becoming wider in the middle; ¾–½ inch thick below, slightly concave ; margin serrulate with minute rather obtuse cartilaginous teeth about $\frac{1}{20}$–$\frac{1}{10}$ line in length. The flowering stalk was 37 inches high, 17 inches of which formed a dense spike of flowers ; the whole stock closely beset with spreading or recurved bracts 5–6 inches long, subulate-filiform from an oval base. Flowers in pairs, their short pedicels with conspicuous membranaceous bracts, about half as long as the ovary. Flowers (fig. 138) only about 1 inch long; ovary as well as perigone only ½ inch long each; the latter divided nearly to the base, tube being only ½ line deep ; lobes oblong-oval, spreading ; stamens inserted in the throat, four times as long as the lobes; style at last longer than stamens ; anthers 4 lines in length when fresh.

The minutely serrulate, narrow, but yet fleshy leaves, the numerous flexuous or recurved bracts of the stalks, the very conspicuous membranaceous bracts on the pedicels, and the small size of the flowers with the very long filaments, contribute to make this one of the most curious species of the genus. It was found in the same locality, near Monterey, where Agave Victoriæ Reginæ was collected. Dr. Palmer discovered this Agave, which flowered last year in the Cambridge (U. S.) Botanical Garden, where Mr. S. Watson named and figured it. It seems to be allied to *A. pruinosa*, Lem. (see Baker, Monog., in *Gard. Chron.*, Dec. 15, 1877), at least in the consistency and the margination of the leaves, while in other respects it may stand nearer to *A. yuccæfolia*. — [Dec. 16, 1882, n. s., vol. xviii.]

* This figure, a full-page wood-cut, showing merely the dense *Littæa* habit, is omitted here. — EDS.

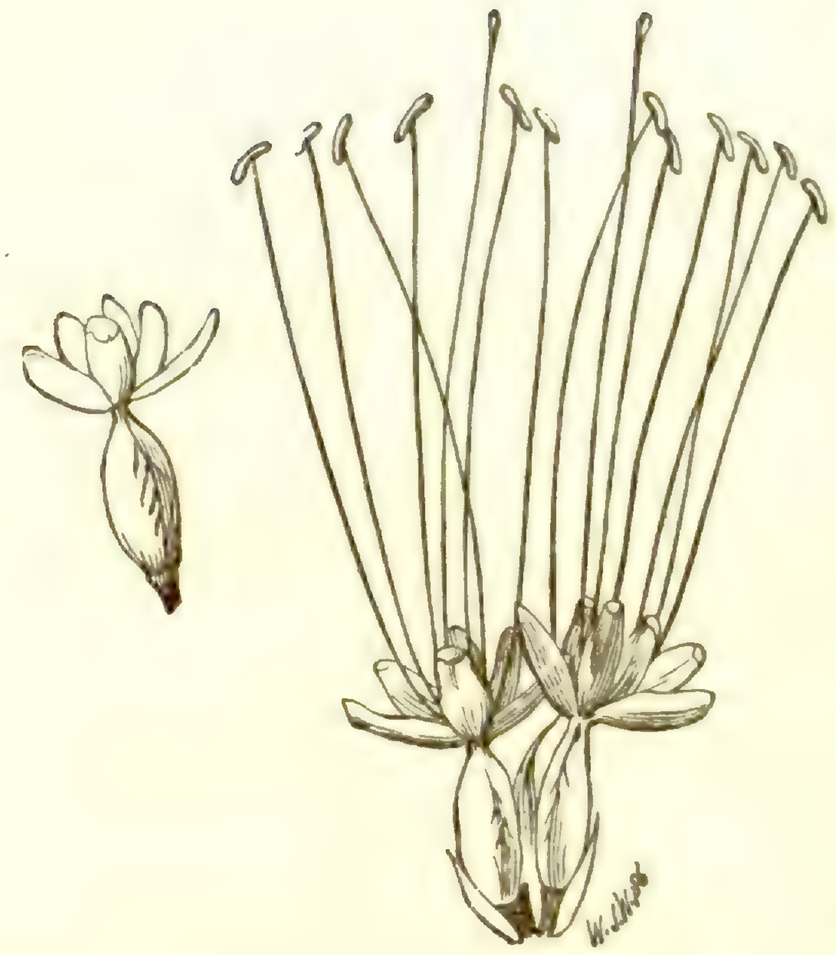

Fig. 138. — Agave bracteosa.

Fig. 139. — Agave bracteosa.

AGAVE HETERACANTHA (*Zucc.*), FORMA GLOMERULIFLORA. — The investigations of Dr. V. Havard of the medical service of the U. S. Army have brought out some interesting morphological facts in regard to this species, which may teach us a lesson about the variability of characters taken from the inflorescence of Agaves. The species (or the form which is known as *A. Poselgeri*), is abundant in the mountain regions of West Texas and along the [48]

FIG. 6. — CAPSULES OF AGAVE.

Rio Grande betweeen El Paso and Presidio, and has there usually narrow leaves $\frac{3}{4}$ to $1\frac{1}{2}$ inch wide, and a foot or less long, and an inflorescence of geminate flowers, but occasionally some more vigorous specimens are found with much larger leaves over 2 inches wide ; others bear the flowers in clusters instead of pairs, three to six, and even ten, in number, on stout, flattened peduncles, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, which seem to form an approach to the paniculate character. The figure (fig. 6) represents a cluster of ten capsules, mostly denuded of the remnants of the flowers, and the diagram shows their arrangement. — [Jan. 13, 1883, n. s., vol. xix.]

VII.

PAPERS ON CONIFERÆ.

I. ON PINUS ARISTATA,

A NEW SPECIES OF PINE, DISCOVERED BY DR. C. C. PARRY IN THE ALPINE REGIONS OF COLORADO TERRITORY, AND ON SOME OTHER PINES OF THE ROCKY MOUNTAINS.*

From the Transactions of the St. Louis Academy of Science, Vol. II. 1863.

During his first botanical expedition to the Pike's Peak region, Dr. Parry, in searching [205] for James' *Pinus flexilis*, found, instead of one, two five-leaved pines, which evidently had been confounded by Dr. James; thus the discrepancies of his description are fully explained. His general description of the tree and the edible seeds belong to what we now name *P. flexilis*, while the "erect cones" (smaller than those of *P. rigida*) "with unarmed scales" must be either very imperfect young ones of this, or old ones of the new species, which had lost their awns.

Pinus aristata, *spec. nov.*: arbor mediocris seu humilis; foliis dense congestis quinis uncialibus integris acutiusculis ex axillis perularum per plures annos persistentium, squamis vaginantibus obtusis mox patulis squarrosis demum totis deciduis; amentis masculis ovatis involucro 4-phyllo munitis in axilla bracteæ ovatæ acuminatæ persistentis stipitatis, antherarum crista ad umbonem parvulum singulum vel binos reducta; amentis femineis erectis herbaceo-echinatis atro purpureis; strobilis ovatis horizontalibus violaceo-fuscis, squamarum elongato-cuneatarum apophysi rhombea parum tumescente transverse carinata medio in umbone parvo breviter aristata; seminibus ala ipsa oblique obovata duplo minoribus.

On alpine heights, between 9,200 and 11,800 or 12,000 feet high, on Pike's Peak and the high mountains of the Snowy Range, *Dr. Parry*, 1861 and 1862; *Messrs Hall & Harbour* (Coll. No. 530), 1862. Also on the heights of the Coochetopa Pass, nearly S. W. of Pike's Peak (altitude over 10,000 feet), where Capt. Gunnison discovered in 1853 what seems to be this species without fruit (see Pac. R. R. Rep. II., p. 130); the leaves which I could compare are those of our plant. Flowers end of June and beginning of July. Flourishing best in the higher elevations and never descending below 9,000 feet, in its lower ranges not ripening its fruits as well as on the bleak heights, this truly alpine species — in that respect our representative of the European *P. Pumilio* — characterizes the highest belt of timber on the peaks of Colorado. On sheltered slopes a tree 40 or 50 feet high and 1–2 feet in diameter, it becomes a straggling bush, prostrate, and almost creeping, on the bleak summits of the high ridges. The bark is thin and scaly, even in older trees not more than 3 or 4 lines thick, of a light grayish-brown color; that of younger branches smooth, with many large vesicles containing a clear fluid balsam, which remains between the layers of the old bark. Wood [206] white, tough, not very resinous; of extremely slow growth, so that a small smooth-barked stem of 13 lines diameter exhibited about fifty annual rings, all between $\frac{1}{6}$ and $\frac{1}{60}$ line wide, the smaller ones consisting of 3–6, the widest ones of 15–25 layers of cells, each cell 0.007 line in diameter. A tree of 2 feet thickness would at that rate indicate an age of over 1,000 years; but the annual rings of larger trees growing in favored situations are wider, and, if a specimen sent by Dr. Parry is not mislabelled, sometimes as wide as $\frac{1}{3}$ line, giving the largest trees a probable age of 500–800 years. Branches spreading, very often many of them twisted, stunted, or dead; the larger branches and the stem

* For a German translation by Schlechtendal, see Flora, XXXIII. (XVII.) 383–394. — Eds.

itself frequently covered with young branches or shoots, which seem to keep life in the old trunk. Leaves crowded from the axils of ovate, acuminate, brittle, at first light brown scales, which, persisting longer than the leaves themselves, cover the branches with their rough blackish remains; leaves light green on both sides without white dots, mostly with numerous exsudations of white resin, usually curved upwards, entire on edges and keel, abruptly acutish, stouter in fruit-bearing, more slender in such trees as produce principally male flowers, in very robust specimens 1¼ and rarely even 1½, usually about 1 inch long; on sterile branches straight and horizontal, "giving the branches the appearance of so many bottle brushes." The vaginæ consist of 7–8 oblong scales with fringed margins, adpressed and forming a sheath 3–4 lines long on the young leaf, soon spreading and squarrose, falling off in the second or third year. Many lanceolate acuminate scales, perulæ, sheathe the lower part of the young shoots; shorter and broader bracts, bearing in their axils the male aments, follow next. The aments together form a very short spike, or rather head, 6 or 8 lines long; often these heads persist on the axis for 2 or even 3 years with a few bunches of leaves above each one, giving the appearance of a leafy spike 1 or 1½ inches long! Our figure does not represent this condition distinctly, but it shows the numerous naked spaces, about 10 in number, which in former years had been occupied by male flowers. I have seen branches with 16 such naked spaces, proving that leaves were persistent for 16 years, — a fact unheard of among pines, where leaves are said to endure generally only 3 years. The stipitate oval ament 3–4 lines long, has a proper involucrum of 4 oblong scales or bracts of equal length. It seems that the involucrum of the male ament and the form of the ament and of the anthers, together with the fruit and seed, offer characters of importance for the distinction and arrangement of species, hitherto neglected probably because living nature has not been studied as diligently as the dried mummies of the herbaria, and these contain so few good flowering specimens of Pines; the number of leaves, so much relied on, is of secondary consideration, and is often calculated to mislead, separating [207] the most natural affinities, such as our Cembroid Nut-pines with 1–5 leaves, or the Pineoid Pines (*P. Pinea, P. Sabiniana, P. Torreyana*) with 2–5 leaves. *P. sylvestris* has an oval ament 3 lines long, with an involucrum of 3 spatulate scales in the axil of a lanceolate recurved bract, which is deciduous before the ament; anther with a short, nearly entire crista. *P. Austriaca* has a cylindric curved ament 1¼ inches long, with an involucrum of about 10 very unequal and almost distichous oval scales, in the axil of a linear-lanceolate recurved persistent bract; anther, with a semicircular entire crista, large enough to entirely hide the body of the anther in the yet closed ament, and give the latter the appearance of a young cone. — Crista of the anther scarcely indicated by a knob, smaller than in any pine examined by me. Female aments single or 2 together, near the end of the young shoot, bristling with the lanceolate, aristate, erect scales, of purple-black color. Cones oval, obtuse, 2¼–2½ inches long, about half as much in diameter, often covered with resin as if varnished; their purplish-brown or blackish color is found also in a little group of alpine pines of the Popocatepetl with 3–5 leaves, discovered by Roezl. Bracts, as in all pines, not obliterated ("evanidæ"), as is usually stated, but much altered, and rather indistinct; more or less thickened, and partly connate with the base of the scale; in our species, only the upper obtuse mucronate part membranaceous and free; scales 10–15 lines long and 4–6 lines wide at their exposed part; transverse ridge of the rhombic, rather flat, protuberance of the scale very conspicuous; the slender mucro or awn, from the small rhombic central knob, 2–3 lines long, curved upwards, at last tortuous and easily broken off, has suggested the name for the species. Seed nearly 3 lines long, with the obovate wing 6–7 lines long; embryo in all the seeds examined by me with 7 short cotyledons.

Systematically, this species belongs to Endlicher's section *Pseudostrobus*, which comprises many Mexican, some Central American, and a single West Indian species; it is its only representative in the territory of the United States.

EXPLANATION OF THE PLATES [Reproduced on pp. 328-9].

Pl. 5. Branches gathered about July 1st; the upper one with stouter leaves and half grown cones, about a year old, the young shoot of the present year just pushing out, showing the scales variously broken, and in their axils the tips of the young leaves.

The lower branch, with more slender leaves, bears male flowers.

Pl. 6, Fig. 1, 2. Ripe cones — a smaller one closed and a larger one with open scales; *a, b, c*, single scales from the side and upper surface, and seeds; these are incomplete, the only ones then seen by me; better ones are figured Pl. 11, Fig. 7 — *a*, external or upper; *b*, internal or lower side. Fig. 8, embryo 10 times magn.

Fig. 3, 4. Fascicles of leaves, 2 magn. Fig. 3, young ones with their bract; Fig. 4, full grown ones with the [208] sheathing scales recurved.

Fig. 5. Upper part of leaf of the fruit-bearing branch, 10 magn.; upper or inner side (section at base not correctly drawn).

Fig. 6, 7, 8. Sections of leaves dry and the same soaked, 10 magn.; f. 6, section of Fig. 2; f. 7, of another leaf; f. 8, of a leaf of the male branch.

Fig. 9. Bunch of male aments with their perulæ and bracts; the obtuse involucral bracts visible between the others; 2 magn. *a*. An anther from above, 10 magn.; depauperate crista visible at the end of the commissure. *b*. Pollen, 100 magn.

Another 5-leaved species of the Rocky Mountains, first noticed more than 40 years ago, but hitherto very imperfectly known, is

PINUS FLEXILIS, *James, in Long's Exped.* 2, *pp.* 27, 34. *Torrey, in Ann. Lyc. N. Y.* 2, *p.* 249 : arbor mediocris seu elatior ; foliis dense confertis quinis sub-biuncialibus rigidis integris acutiusculis ex axillis perularum lanceolatarum deciduarum, squamis vaginantibus obtusis laxis mox evanidis ; amentis masculis ovatis involucro sub-8-phyllo munitis in axillis bracteæ lanceolatæ patulæ deciduæ sessilibus, antherarum crista minore irregulariter inciso-dentata ; amentis femineis subverticillatis in pedunculo brevi perulis late lanceolatis acutis dense stipato erectis squarrosis ; strobilis ovato-cylindraceis squarrosis horizontalibus seu declinatis e rubello fuscis, squamis e basi breviter cuneata latissimis orbiculato-rhombeis, apophysi convexa semicirculari incrassata margine area parva subrhombea inermi notata ; seminibus magnis obovatis exalatis carinatis.

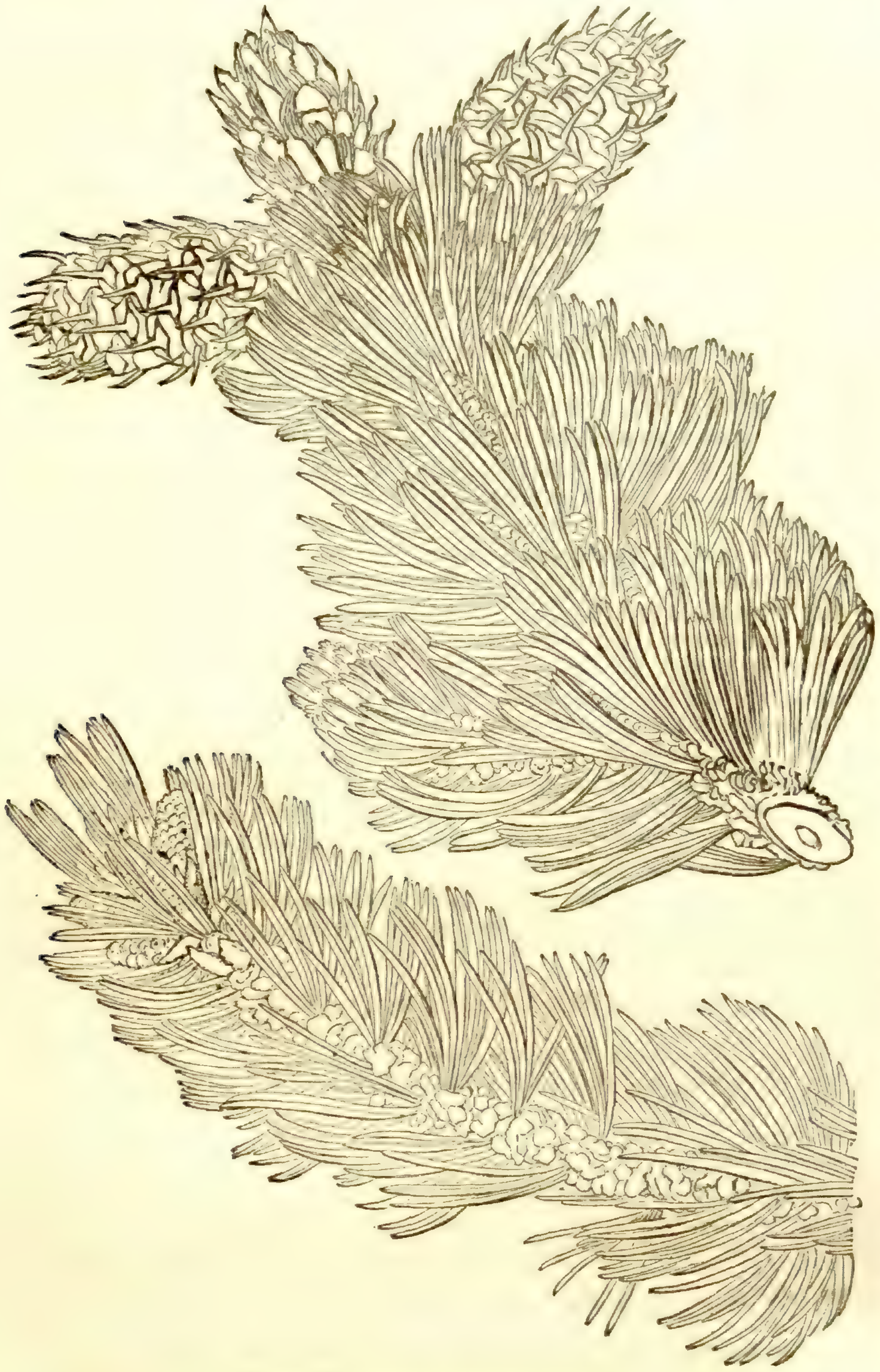

PLATE V. — PINUS ARISTATA (p. 327).

On the Rocky Mountains, from New Mexico to the 49th parallel, "occupying the subalpine belt, never forming entire forests, in the lower elevation associated with *P. contorta*, approaching the alpine districts, scattering with *P. aristata*" (Parry's Notes) ; on the Sandia Mountains, New Mexico, 12,000 feet high, to the top, *Dr. Bigelow ;* mountains of Santa Fé, *A. Fendler* (No. 832) ; Colorado, *James, Parry, Hall & Harbour* (No. 529) ; Laramie Mountains, *H. Engelmann ;* mountains from the Platte to the Bear River, *Nuttall ;* Wind River Mountains, *Fremont ;* Big Horn Mountains and mountains at the headwaters of Snake River, *Dr. Hayden*, to the British boundary, *Dr. Lyall.* Nuttall's figure in his Sylva, pl. 112, is very poor, and even quite incorrect ; nor can I learn that any specimen of his is preserved in the herbarium of Mr. Durand or of the Academy of Natural Science, in Philadelphia, but suppose that he had our species in view.—*P. flexilis*, the American representative of *P. Cembra* of the Old World, is a middle-sized

tree, usually 30–50 feet high, though Fendler, a good authority, saw it near Santa Fé 60–80 feet high; Dr. Bigelow's trees, of the height of 100–130 feet, on the San Francisco Mountain (Bot. Whipple, p. 20), must belong to some other 5-leaved species. In Colorado it is a fine tree, with tapering trunk and oval outline, branching almost [209] from the base, lower branches horizontal, upper ones ascending; wood white, hard, annual rings from $\frac{1}{8}$ to $\frac{1}{2}$ line, on an average $\frac{1}{4}$ line wide; trees become in 250–300 years about 1 foot thick. Leaves crowded towards the end of the very flexible branches, persistent 5 or 6 years, usually $1\frac{1}{2}$–$2\frac{1}{2}$, very rarely 1 or 3 inches long; sheaths similar to those of *P. Strobus* or *P. Cembra*, 8 lines long, deciduous. Male aments 4–5 lines long, forming a thick spike 10–12 lines long, cones subcylindric, tapering to the end, 4–5 inches long, 2 inches in the largest diameter, on short peduncles; scales 12–14 lines long, 10–12 lines wide, squarrose; lowest sterile ones recurved; fertile ones with deep impressions for the reception of the seeds both on the upper inner side and on the back, the latter cavities partly formed by the large (4–6 lines long) ligneous or rather corky bract. Seeds 4–5, rarely 6 lines long, irregularly ovate or obovate; wing minute, not deciduous nor adhering to the scale, as in *P. Cembra*, *P. edulis*, etc., but reduced to a persistent keel on the upper end and outer edge of the seed; embryo with 8 or rarely 9 cotyledons.

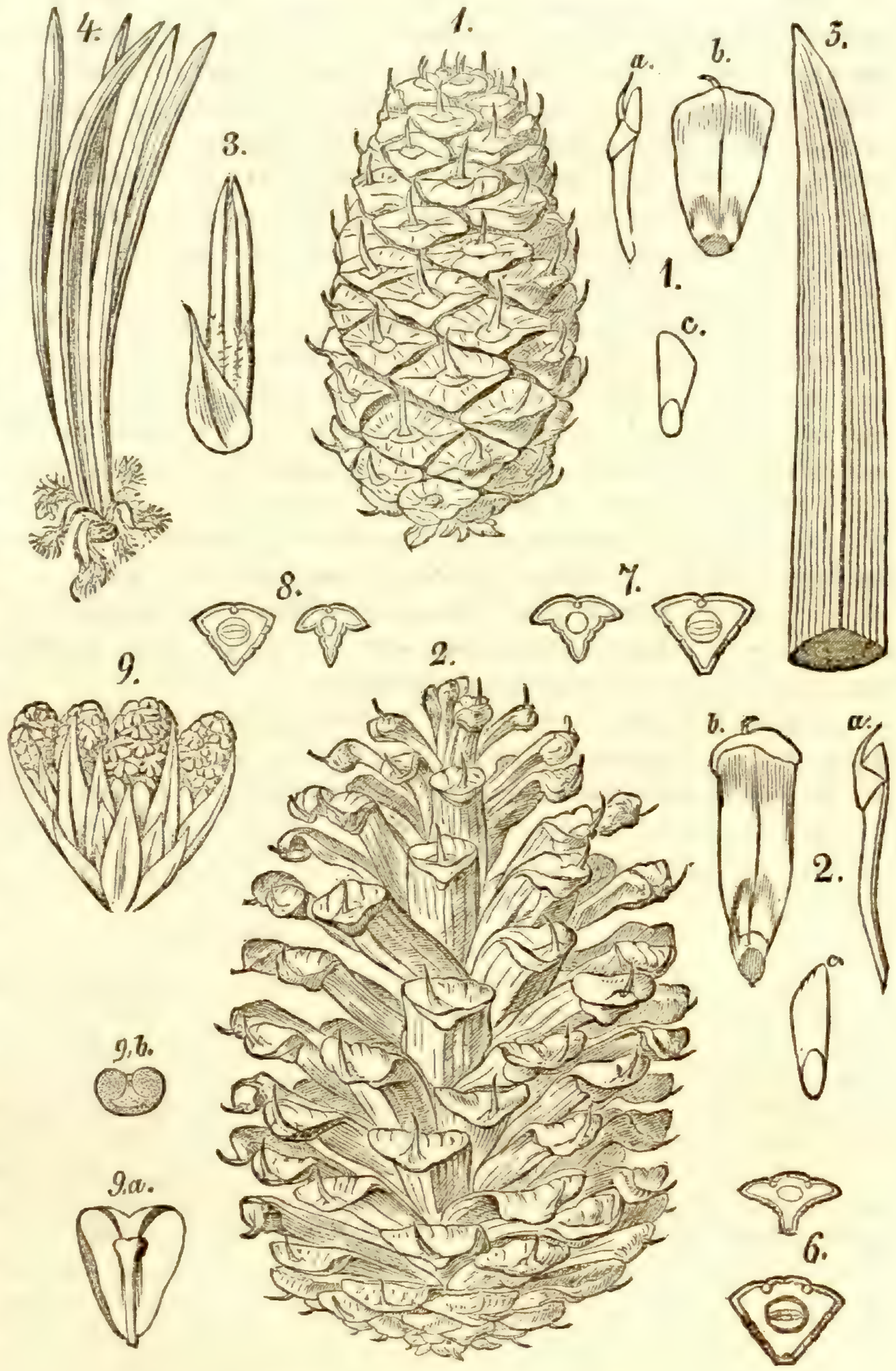

PLATE VI. — PINUS ARISTATA (p. 327).

PINUS ALBICAULIS. *P. cembroides*, *Newberry*, *Pac. R. R. Rep.* 6, *Bot.*, *p.* 44, *c. ic.*, *non Zucc.*, an alpine species from the Cascade Mountains, in Oregon, may be a western form of this species, though I am inclined to consider it as different, and intermediate between *P. flexilis* and *P. Cembra*, distinguished by the pubescent branchlets, few scattered teeth on the edges of the leaves, and especially by the short oval cones with thick squarrose scales pointed with a knob. The name is suggested by the color of the bark of the tree, which is "as white as milk."

While studying the Coniferæ of the Rocky Mountains, I was led to investigate the characters of the different types which Linnæus had comprised in his genus *Pinus*. The great master himself had at one time thought proper to divide that rather incongruous mass, considering *Abies* as distinct

from *Pinus*, reuniting them, however, afterwards. Since then many botanists have investigated this interesting subject, and while some of the highest standing — I mention only the names of Endlicher and Hooker — have adhered to the Linnæan circumscription of the genus, others of no less authority have thought it more natural to recognize the distinctions already made by popular language, and some of them adopted by the older botanists. The first who more thoroughly examined the question was Link, who (Linnæa, Vol. 15, 1841) characterized 5 genera, *Abies*, *Picea*, *Larix*, *Cedrus*, and *Pinus*. Endlicher, in Synops. Conif., 1847, further separated Link's *Piceæ desciscentes* under the name of *Tsuga*, considering all these as subdivisions of the genus *Pinus*. Carrière [210] (Traité des Conifères) adopted Link's genera, with Endlicher's addition, without further developing their distinctive characters. My investigations lead me to adopt Carrière's views, more firmly establishing those six genera, — not without some misgivings, however, as it will appear from the following, that, besides the characters derived from the organs of fructification, in one instance at least the characters of vegetation have also to be brought in to distinguish two apparently not very nearly allied genera, Larix and Tsuga; while others, thought to be closely connected, such as Picea and Tsuga, or Larix and Cedrus, recede far from each other in their essential organs. Otherwise the characters of fructification and vegetation go so well together as materially to confirm one another and to establish the generic differences. An interesting fact is, that the pollen grains of Abies, Tsuga, and Picea are largest (in four species 0.053–0.060 lines in the longest diameter), those of Cedrus smaller (in two species 0.042–0.043 lines), and those of Pinus the smallest (in four species 0.034–0.038 lines). Will the characters of vegetation, after all, outweigh those of fructification, and will we have to fall back to old Tournefort's views and recognize his three genera, — *Abies*, with single leaves and large pollen; *Larix*, with crowded leaves and middle-sized pollen; and *Pinus*, with fasciculated, sheathed leaves and small pollen?

I have, with Du Roi, Link, and Endlicher, and against Linnæus', Lambert's and Loudon's authority, adopted the ancient Plinian name of *Picea*, the *pitch* tree, for those with quadrangular leaves and pendulous cones, the original representative of which is the well-known pitch tree of Europe, here usually called "Norway Spruce," and the name of *Abies* also in the Plinian sense for those with flat leaves and erect cones, the Fir trees.

ABIETINEÆ VERÆ.

I. ***Fructificatio annua;*** **squamæ strobili tenuiores bracteis plerumque tenuibus pergamentaceis hinc excrescentibus rarissime lignescentibus suffultæ. Semina facie superiore basi alæ fere persistentis obtecta eaque plus minus inclusa. Amenta mascula femineaque perulis indefinitis suffulta, in ramulis anni prioris axillaria, rarius terminalia; antheræ variæ. Folia singula seu, axi abbreviata, fasciculata integerrima.**[1]

§. Antheræ connectivo apice apiculato recurvato, loculis rima transversali dehiscentibus confluentibus. [211] **Folia subtus carinata, supra canaliculata planave.**

1. Abies, *Link:* squamæ strobili erecti maturitate ab axi deciduæ; semina basi alæ inclusa libera, testa vesiculis balsamiferis repleta; amenta mascula in axillis foliorum versus apicem ramorum annotinorum sessilia; folia petiolata, pseudo-disticha, cicatricem circularem relinquentia, sicca persistentia. — *Fir.*

2. Tsuga, *Endl. sub Pino; Carrière:* squamæ strobili cum ramulo declinati persistentes; semina basi alæ adnata; amenta mascula in axillis foliorum versus apicem ramorum annotinorum sessilia vel terminalia; folia petiolata pseudo-disticha, cicatricem semicircularem relinquentia. — *Hemlock-spruce.*

Micropeuce, Spach: bracteæ strobili inclusæ; testa vesiculis balsamiferis repleta; folia sicca decidua.

Peucoides, Spach: bracteæ strobili exsertæ; testa vesiculis balsamiferis destituta; folia sicca persistentia.

3. Larix, *Link:* squamæ strobili in ramulo brevissimo terminalis nutantis seu adscendentis persistentes; semina basi alæ adnata, testa vesiculis balsamiferis destituta; amenta mascula ex apice ramulorum abbreviatorum annotinorum; folia angustissima, fasciculata, sola inter cætera annua, cicatricem triangularem relinquentia, sicca decidua. — *Larch.*

[1] Though the leaves are usually entire, I have seen a seedling of *Picea excelsa* from the woods of Trient, in Switzerland, with spinulose leaves; whether that is the ordinary occurrence I do not know. The young of *P. nigra*, from the White Mountains, have entire leaves.

§§. Antheræ connectivo apice in cristam transversam circularem seu semicircularem recurvatam excrescente, loculis longitudinaliter dehiscentibus distinctis. Folia infra supraque carinata tetragona cicatricem subrhombeam relinquentia, sicca decidua.

4. CEDRUS, *Link:* squamæ strobili in ramo breviter minalis erecti versus apicem incrassatæ, demum ab axi solutæ cum bracteis lignescentibus deciduæ; semina alæ basi laceræ adnata, testa vesiculis balsamiferis repleta; embryo solus inter cæteros curvatus; amenta mascula ex apice ramulorum annotinorum fere biennia (ætate præcedente evoluta); folia fasciculata. — *Cedar.*

5. PICEA, *Link:* squamæ strobili nutantis vel cum ramulo declinati persistentes; semina demum e basi alæ liberæ decidua, vesiculis balsamiferis destituta; amenta mascula in axillis foliorum versus apicem ramorum hornotinorum sessilia; folia circum axin undique porrecta. — *Spruce.*

II. *Fructificatio biennis;* squamæ strobili sublignosæ, apice apophysi sæpius pyramidata incrassatæ, cum bracteis plus minus lignescentibus persistentes. Semina basi alæ demum deciduæ velut annulo cincta vesiculis balsamiferis destituta (ala in paucis angustissima squamæ adhærens, in singula P. flexili cariniformis persistens). Amenta mascula ex axillis bractearum scariosarum orta, squamis scariosis sub-definitis involucrata, in infima ramulorum [212] hornotinorum parte in spicam compositam congesta; antheræ connectivo apice in umbonem sæpius emarginatum seu in cristam transversam variam excurrente, loculis longitudinaliter dehiscentibus distinctis. Amenta feminea in ramulis hornotinis subterminalia singula seu subverticillata. Folia ex axillis perularum singula-quina, basi vaginis membranaceis polyphyllis inclusa, integra seu margine et carina superiore serrulata; singula teretia, bina supra plana seu demum concava, dorso convexa, plura supra carinata, dorso plana seu convexa.

6. PINUS, *Linn. Gen. ed.* 1, *Link.* — *Pine.*

PICEA ENGELMANNI,* *Parry, sub Abiete, St. Louis Trans.* 2, *p.* 122. *Abies nigra, Engel. in Sill. Journ.* 33, *p.* 330, *non Poir.:* arbor elatior, pyramidata; cortice tenui squamato rubello; ramulis pubescentibus; perulis ovatis obtusis squarrosis; foliis confertis robustis compresso-tetragonis abrupte acutiusculis plerumque curvatis; amentis ovato-cylindricis perulis late ovatis involucratis, feminearum bracteis squamas ovatas obtusas crenulatas squarrosas longitudine subæquantibus; strobilis ovato-cylindricis obtusis terminalibus lateralibusve cum ramulis suis horizontalibus seu declinatis, squamis tenuibus obovato-rhombeis apice plus minus truncatis emarginatis crenulato-erosis; seminum ala oblique obovata.

Higher parts of the Rocky Mountains, from New Mexico to the headwaters of the Columbia and Missouri Rivers, and probably further; from the subalpine to the alpine districts, and with *Pinus aristata* reaching the highest limits of timber; occupying in Colorado a belt between the limits of 8,000 and 12,000 feet, it reaches its fullest development between 9,000 and 10,000 feet, near the headwaters of the streams on both slopes of the Snowy Range, constituting magnificent forests about the head of Middle Park, at Tarryall, etc., often mixed with *Abies grandis;* not found lower down, e.g. at Fontaine-qui-bouit, where *Picea Menziesii*, with *Tsuga Douglasii*, reign as monarchs of the forest. Flowers end of June.

In its most favorable localities this species makes a stately tree, 60-100 feet high, forming a narrow, sharply-tapering spire, of a rather darkish hue; trunk perfectly straight, columnar, tapering very gradually, 1½–2½ feet in diameter; branches mostly small, lower ones horizontal, upper ones ascending: on higher altitudes it is a smaller, nearly round-topped tree, very much branched, bearing more perfect fruit than in either lower or higher elevations: on the highest summits a prostrate and almost creeping, sterile shrub, just as *Picea nigra* is found on Mt. Washington, N. H. Bark only 1–1½ lines thick, scaly, reddish, grayish-purple or light purplish-brown, containing much tannin; [213] wood soft, white, not knotty nor resinous, therefore much esteemed for inside and cabinet work; annual rings ¼–1¼ lines, on an average ⅔–1 line wide. Leaves stouter than they usually are in *P. alba* or *nigra*, but less so than in *P. Menziesii;* in the higher localities 6–9 lines long and not quite 1 line wide; strongly carinate below, less so above, with a few lines of white stomata above and below, abruptly but not sharply acute; in lower localities the leaves are more slender and 8–12 lines long, and if I am correct in referring here some doubtful forms, it occurs also with whiter, more slender, and longer leaves (10–15 lines, *Fendler*, No. 833, from a young tree without cones, mountain valley above Santa Fé), and with almost glabrous branches, and still more slender and very acute leaves (5–10 lines; *Dr. Hayden*, from the Big Horn Mountains; detached cones from that locality certainly belong here). I find the leaves in this genus extremely variable; *P. nigra* at least, of which I have been able to compare a large number of specimens, varies so much, that any attempt to base specific characters on the form of the leaves seems nugatory; the leaves in that species are straight or curved, slender or stout, quadrangular or compressed, — acute, subacute, or very obtuse, — whitish,

* A reprint of the account of this species, credited by mistake to the "Transactions of Academy of Sciences of Philadelphia," occurs in the *Gardeners' Chronicle* for Oct. 31, 1863, p. 1035. — EDS.

pale, or dark green, — usually only 4–6, but also 10–15 lines long; the fruit, however, differs in its position from that of all other Piceæ known to me, being borne on short, recurved, scaly peduncles; it is 10–20 lines long, oval, acutish; scales thick at base, very thin at the crenulate edges. *P. alba* is also best characterized by the slender cylindric cones, 1–3 inches long, with thin scales, entire but not thickened, as I inadvertently stated in Sill. Jour. l. c. The true characters and the limits of variation of these species are now being investigated by Prof. O. Brunet of Quebec, who, living in the midst of them, will be able to solve many doubts heretofore existing, and to give us their correct history. — Male aments of *P. Engelmanni* 6–9 lines long, on short stipes; anthers $1\frac{1}{3}$ lines long; female aments 9–10 lines long, with ovate lanceolate scales almost equalling in length the dark purple, fleshy scales. Cones scattered on the tree, never very abundant, $1\frac{1}{2}$–$2\frac{1}{4}$ (usually less than 2) inches long, $\frac{3}{4}$ inch or less in diameter when closed; light yellowish brown with the lower part of the scales dark when fresh, all reddish-brown when old; scales 6 lines wide, and 6–8 lines long in well grown specimens, rhombic with truncated end; in poorer ones, such as grow in lower elevations, shorter, more rounded, with the truncation indistinct. I observe the same difference in cones of *P. excelsa*, grown on bushy trees near their *upper* limit in Switzerland; there also cones, scales, and seeds are smaller, and the truncation of the scales is almost imperceptible. Seeds about 1 line long without, and $4\frac{1}{2}$ lines long with the wing, which here, as in all Piceæ, overlaps the inner edge of the seed, dropping it at maturity; cotyledons, as in most species, 6, rarely [214] 5; in *P. excelsa* I find 8, or rarely 9 (not 2–3, as Endlicher inadvertently stated), and in the alpine specimens, mentioned above, only 6 cotyledons.

Picea Menziesii, the only other species of Colorado, is entirely subalpine, occurring between the limits of 7,000 and 9,000 feet in low, moist, or marshy soil, especially on the borders of streams; it is, as Dr. Parry informs me, a tree of a more oval outline, pointed upwards, with a more rapidly tapering trunk; thicker ($\frac{1}{2}$ inch), grayish, moderately rough bark; rapidly-growing (annual rings $1\frac{1}{2}$–2 lines on an average), harsh-grained, brittle, knotty, resinous wood; stout, light colored, smooth, glossy branchlets; stout, broad, sharply-pointed leaves; longer (9–12 lines) male and female aments, the latter composed of pale, glistening, orbicular scales, which are many times longer than the minute bract; cylindric cones (3–$4\frac{1}{2}$ inches long, drooping perpendicularly with the branch or usually at an angle with it, abundant even on young (12–15 feet high) trees, crowded especially towards the top of the tree and very conspicuous, whitish at maturity, but turning light brown and persisting on the tree for another year until the new crop matures; scales elongated rhombic, 9–11 lines long, truncate, more than twice as long as the seed with its triangular obovate wing. The alpine *P. Williamsonii*, Newb., from the Cascade Mountains, Oregon, which I have not been able to compare, seems to be well distinguished by its peculiarly reflexed scales.

II. CONIFERÆ OF DR. PARRY'S COLLECTION IN THE ROCKY MOUNTAINS.

(BY DRS. PARRY AND ENGELMANN.)

From Amer. Journ. Sci. and Arts, second series, Vol. XXXIV, Nov. 1862.

Dr. Parry collected too few specimens of the following Coniferæ for distribution, but as [330] his notes are replete with interest they are given here (under marks of quotation) together with a few remarks of my own.

Abies grandis, *Lindl.* Not common in this region, resembling much the Eastern *A. balsamea*. Fendler's N. Mex. No. 828 is the same.

Abies Douglasii, *Lindl.* "Abundant through the eastern mountain district, except on the higher elevations. A very sightly tree, of the average height of 80 feet, with a graceful oval outline; the spreading branches curving upwards at the extremities. Wood of slow growth, but very indifferent, inclined to warp and crack, turning reddish-brown in drying." This species, as well as the nearly allied *A. Canadensis*, is well distinguished from all our other Pines by the distinctly petioled leaves. Fendler's N. Mex. No. 829.

Abies Menziesii, *Lindl.* "A finely shaped tree, though of rather stiff outline, of rapid growth; wood very compact, but rather coarse-grained and pitchy; the logs taper too rapidly to saw up to advantage." Cones pendulous from the end of the branches. Leaves stouter than in any other allied species, stiff and very acute, almost spinescent.

Abies nigra, *Poir.* Probably the same as the northeastern tree (characterized by the slender and very acute leaves, ovate cones with thin and crenate margin of the scales), a pale-leaved form of which is usually named *A. alba*, but which Prof. Gray has demonstrated to belong to *A. nigra*. The true *A. alba* (leaves somewhat stouter and obtusish,

cylindric cones with thickened entire margin of the scales) seems to extend from Canada to the northern Rocky Mountains, where it has been gathered by Bourgeau ; but it has not fallen under Dr. Parry's or Dr. Hayden's observation, on the headwaters of the Kettle, Colorado, Missouri and Columbia Rivers, where *Abies nigra* seems to be abundant, extending down to Santa Fé (Fendler, N. Mex. No. 833). Dr. Parry found it "composing almost the entire [331] forest growth of the mountain slopes of Middle Park about the head of Grand River ; a magnificent tree, 80 to 100 feet high, with an even, columnar trunk, below 2–2½ feet in diameter, tapering upwards ; of rapid growth ; bark scaly, smooth, and quite thin, of a purplish-brown color, full of tannin, and quite different from the rough brown bark of *A. nigra* of Wisconsin ; wood remarkably white and soft, free of knots and scarcely resinous, preferred for inside work." Could this be *Abies rubra* Loud., and specifically distinct from *A. nigra ?*

PINUS ARISTATA, *Engelm., in St. Louis Transact., vol.* 2, *tab.* 5 *and* 6. Dr. Parry had the good luck to discover this very peculiar and exclusively alpine species "which does not descend lower than 9,000 or 10,000 feet," on the higher mountains of Clear Creek. As a full description and a figure has been given in the Transactions of the St. Louis Academy, I confine myself here to the statement that it is our only representative of Endlicher's section, *Pseudostrobus*, which comprises numerous Mexican, a few Central American, and a single West Indian species ; it is characterized by quinate entire leaves and horizontal ovate cones, with thin apophyses on the long-mucronate or aristate scales, and small winged seeds. In sheltered situations it forms a tree 40 or 50 feet high and 1 or 2 feet in diameter, but on the higher bleak mountains it is a stunted bush, often thickly covered with fruit. Its growth, at least in the latter localities, is exceedingly slow, as a stick of scarcely more than one inch in diameter, brought back by Dr. Parry, shows nearly fifty annual rings, some of them $\frac{1}{60}$ of a line, and none more than $\frac{1}{8}$ of a line wide.

PINUS FLEXILIS, *James.* This species, discovered in the same regions by Dr. James, has to some extent remained doubtful, as his description in the account of Long's Expedition, and Torrey's diagnosis in the Annals of the New York Lyceum (vol. ii. p. 249) are based on notes only, no specimens having been collected. By later writers it has been ignored, until Mr. Fendler in 1847 collected it on the mountains above Santa Fé, (Coll. N. Mex. No. 832), when a short notice was published by the writer in the appendix to Wislizenus' Memoir of a Tour to New Mexico, etc., 1848. Endlicher, in his Synopsis Coniferarum, 1847, does not enumerate it, and Carrière in his Traité des Conifères, 1855, credits it to Wislizenus, translating only my short remarks. Nuttall, however, had already (in 1849) given a somewhat extended account of it, with a poor figure, in the continuation of Michaux's Sylva (vol. iii. p. 107, pl. 112), without clearing up the doubts, which Dr. Parry in his present expedition, 1862, is expected finally to settle. My brother, H. Engelmann, collected it on the headwaters of the Platte, and Dr. Hayden on the mountains about the headwaters of the Yellowstone, Missouri, and Columbia rivers. Dr. Parry notes that the cones grow several together, "semipendulous," at the extremity of the horizontal branchlets ; while James gave his plant "erect" cones. Near Santa Fé it grows at the elevation of 8,000 or 10,000 feet, and in favorable situations becomes 60 or 80 feet high and bears "pendulous" cones, according to Fendler's note. *Pinus flexilis* is certainly intermediate between the sections *Cembra* and *Strobus* of Endlicher, and unites the two, as does *P. cembroides*, Newberry, Pacif. R. Rep., vol. vi. Bot., p. 44, [332] not Zucc.,[1] if indeed this is not a mere form of *P. flexilis*, approaching by its short cones close to *P. Cembra*. The large seeds of *P. flexilis* are, as Dr. James already stated and as Dr. Hayden confirmed, eaten by the Indians. They are distinguished from those of any other of our Pines by a persistent, sharp, keeled margin, representing the wing.

PINUS PONDEROSA, *Dougl.*, is "common through all the lower valleys and less elevated districts of the mountains, associated with *A. Douglasii* and *A. Menziesii ;* a most valuable timber tree." Fendler's N. Mex. No. 831. Male aments cylindrical, several inches long.

PINUS CONTORTA, *Dougl.*, "is quite abundant on the crest and slopes of dry subalpine ridges, forming the principal part of the forest there, and extending to near the snow line ; a symmetrical tree of rapid growth, 30 or 40 feet high, with slim and tapering trunk a foot in diameter, a smoothish, grayish-brown bark, detached in thin scales, and tough but coarse wood, which is liable to warp, and rarely cut into boards."

[1] Zuccarini's plant of that name is one of the curious little group of American Nut-pines, including the following four species : *Pinus monophyllos*, Torrey and Fremont, with single (not connate, as Endlicher would have it) leaves ; *P. edulis*, Engelm., with 2 leaves ; *P. cembroides*, Zucc. (including *P. Llaveana*, Schiede, not Torr., and *P. osteosperma*, Engelm.), with 3 leaves ; and *P. Parryana*, Engelm. (*P. Llaveana*, Torr. Bot. Mex. Bound., p. 208, t. 53), with 3–5, mostly 4 leaves. Other characters, taken principally from the bracts of the young shoots, strengthen the specific distinctions. This very natural little group is characterized by the small, almost globose cones, the scales bearing large pyramidal apophyses and large edible seeds, the wings of which remain attached to the scale, which, I suspect, is the case in all "wingless" seeds of pines ; in *P. Pinea*, however, the wing is very distinct, and detaches itself clearly from the scale and at the same time also from the seed itself, which is likewise the case in the closely allied, though 5-leaved, Californian *P. Torreyana*, Parry, where the wing, besides, is very thick, and of a corky substance. The great variability in the number of leaves in the nut-pines proves that sectional characters taken from them are without value.

III. UNTERSUCHUNGEN ÜBER DIE ABIETINEEN.

From Sitzungs-Bericht der Gesellschaft naturforschender Freunde zu Berlin, May 19, 1868.*

Die Genera, welche diese Abtheilung der Coniferen bilden, sind durch ihre Wuchsverhält- [13]
nisse, die Bildung ihrer Blätter, die Art der Oeffnung ihrer Antheren, die Gestalt ihres Pollens, die Verhältnisse der Früchte (Zapfen), die Form der Samenflügel und das Dasein oder die Abwesenheit von Harzbehältern auf den Samen aufs Beste charakterisirt.

Einzelnstehende Blätter und innerhalb eines Jahres reifende Früchte haben 1, *Abies* (Link) 2, *Tsuga* 3, *Peucoides* 4, *Hesperopeuce* 5, *Larix* 6, *Cedrus* 7, *Picea* (Link); davon tragen 1–4 flache, 5–7 kantige Blätter, alle, mit den seltensten Ausnahmen, ganzrandig; bei 5 und 6 bleiben die Achsen der Seitenzweige unentwickelt, daher deren Blätter in Büschel zusammengedrängt sind. Alle bisher genannten tragen bekanntlich ihre kätzchenförmigen männlichen Blüthen und ihre weiblichen Blüthenstände in den Achseln vorjähriger Blätter oder an den Enden kürzerer (am kürzesten bei *Larix*, etwas länger bei *Cedrus*) oder längerer Zweige des vergangenen Jahres. Bündel von 1–5 (oder ausnahmsweise bis zu 8 oder 9) fast immer gesägten Blättern, welche Bündel in den Achseln von Schuppen stehen, und erst im zweiten Jahre reifende Früchte charakterisiren bekanntlich 8, *Pinus*; die männliche Blüthen sowohl als die weiblichen Blüthenstände werden von den Trieben desselben Jahres getragen. Andere Gattungen der Abietineen, zumal *Pseudolarix*, habe ich zu untersuchen keine Gelegenheit gehabt.

Die beiden parallelen Antherenfächer öffnen sich der Länge nach bei den drei letzten Gattungen; bei den fünf ersten reissen sie der Quere nach auf. Die Pollenkörner sind bei den meisten Gattungen länglich mit zwei seitlichen etwas nach einer Seite gekrümmten Anschwellungen, bei *Tsuga* aber sind sie flach schüsselförmig und bei *Peucoides* und *Larix* oval; bei *Abies* und *Picea* sind sie ausgezeichnet gross, viel kleiner, aber doch sehr verschieden gross, bei den *Pinus*-Arten.

Die Bracteen innerhalb der Zapfenfrüchte der ersten sieben Gattungen bleiben blattartig, sie mögen sich während der Zeit vergrössern oder nicht, bei *Pinus* aber schwellen sie korkartig an und tragen mit ihrer Rückenfläche wesentlich zur Bildung der Scheinfächer bei, in welchen die Samen liegen.

Bei *Abies* und *Cedrus* lösen sich die Schuppen der reifen Zapfen von der Achse ab, während sie bei allen andern Gattungen persistiren. Meist fallen die Zapfen bald nach völliger Reife ab, bei einigen *Picea*-Arten aber (*Picea nigra* unterscheidet sich unter andern dadurch von *P. alba*) und bei vielen *Pinus*-Arten haften sie mehrere, ja viele Jahre.

Die Samenflügel, von den äusseren Zelllagen der innern Schuppenfläche gebildet, bedecken die obere Fläche der Samen bei den meisten Gattungen vollständig; bei *Abies* schlägt sich diese Decke auch noch theilweise über die untere Fläche derselben; bei *Cedrus* ist sie zerzasert, und bei *Pinus* bleiben bei dem reifen Samen ausser einem mehr oder weniger vollständigen Ringe nur noch Spuren zurück. Die Samen selbst sind bei *Abies*, *Tsuga* und *Cedrus* mit grossen Harzbehältern besetzt, bei den übrigen Gattungen aber fehlen diese. — Die Zahl der Cotyledonen ist geringer (meist nur 3–5) bei den ersten Gattungen, bei *Pinus* und *Cedrus* aber kommen deren bis zu 12 und mehr vor; letzte Gattung hat noch die Eigenthümlichkeit, dass die Embryonen gekrümmt sind, während sie bei allen andern Gattungen fast gerade erscheinen.

Die Begränzung der meisten dieser Gattungen ist längst bekannt; daher sei nur bemerkt, [14]
dass *Tsuga* die bekannten ost-amerikanischen, west-amerikanischen und ost-asiatischen Arten umschliesst, welche sich kaum specifisch trennen lassen. *Peucoides*, von Spach nur als Section geschieden, besteht aus der einzigen Art *Douglasii*; *Hesperopeuce* ist ebenfalls ein monotypes Genus,

* Reprinted, with slight alterations, in Bot. Zeitung, 1868, pp. 484–7. — Eds.

auf *Abies Pattoni* (syn. *A. Hookeriana* und *A. Williamsonii*) gegründet, deren Blüthen ich untersucht, deren Samen mir aber unbekannt sind. Diese drei Gattungen haben im Allgemeinen die Blätter von *Abies* und die Zapfen von *Picea*, unterscheiden sich aber in den andern Organen von diesen beiden und unter einander, wie oben angegeben, auf das bestimmteste.

Ueber *Pinus* wäre nun noch zuzufügen, dass eine natürliche Gruppirung der zahlreichen Arten nicht leicht zu finden ist, dass sich aber die Section *Strobus*, die sich an *Picea* anschliesst, gut charakterisirt durch die gracilen hängenden Zapfen mit wenig verdickten Schuppen und die 5-zähligen Blätter, welche nicht, wie bei allen andern Kiefern, in eine abrupte, ungesägte Spitze auslaufen, sondern auch auf dem stumpflichen Ende fein und unregelmässig gezähnelt sind. An diese schliesst sich *Cembra* an mit grossem Samen und auf ein Minimum reducirten Samenflügeln; die echten *Cembra*-Arten haben noch, wie *Strobus*, wenig verdickte Zapfenschuppen und 5 Blätter, diese sind aber an der Spitze immer und zuweilen selbst am Rande ungesägt; die Unterabtheilung *Cembroides*, unterschieden durch die ungewöhnlich dickhöckerigen Schuppen der kleinen Zapfen, verdient besondere Beachtung, weil die vier Arten, welche sie bilden (*P. monophyllos* mit 1, *edulis* mit 2, *cembroides* = *Llaveana* mit 3 und *Parryi* mit 4–5 Blättern) ungeachtet der Verschiedenheit in der Zahl der Blätter so nahe zusammengehören, dass man sich geneigt fühlt sie als Formen einer einzigen Art zu betrachten, welche vom mittleren Mexico sich nordwestlich bis Californien und Utah erstreckt. Die von einer Scheide umschlossenen stielrunden Blätter von *P. monophyllos* haben übrigens nur einen einzigen centralen Gefässbündel und sind wirklich einfach nicht aus zweien verwachsen, wie die Blätter von *Sciadopitys*; es kommen indessen am selben Baum oder Zweig zuweilen auch zweiblättrige Bündel vor.

Die grosse Menge der übrigen Arten wäre unter der den beiden vorigen coordinirten Gruppe *Pinaster* zu begreifen; man hat sie nach der Zahl der Blätter in 5, 3 und 2 blättrige eingetheilt; da aber viele Arten 2 oder 3, und einige andere 3, 4 oder 5 Blätter in einem Büschel zeigen, so wäre ein genügenderer Eintheilungsgrund zu suchen; ein solcher scheint in der Stellung der weiblichen Blüthenstände, daher der Zapfen, gefunden. Diese stehen entweder am Ende des Jahrestriebes, dicht unter der Terminalknospe, oder sie entwickeln sich, zumal bei vielen amerikanischen Arten, seitlich am Jahrestriebe, gewöhnlich in Quirlen, und zwar so, dass über den Blüthenständen ein beschuppter aber blattloser Achsentheil, und diesem erst ein beblätterter folgt; zuweilen wiederholt sich dies noch einmal. Die erste könnte man *Sylvestres*, die letzteren *Taeda* nennen, nach allgemein bekannten Repräsentanten dieser Gruppen. Dann könnte man vielleicht noch, als Unterabtheilung von *Pinaster* nach der Fünfzahl der Blätter *Pseudostrobus*, und nach der Grösse der Samen und verhältnissmässigen Kleinheit der Flügel *Pinea* trennen, welche letztere Gruppe ausser der europäischen zweiblättrigen *P. Pinea* die west-amerikanischen dreiblättrigen *P. Sabiniana und P. Coulteri* und die 4–5 blättrige *P. Torreyana* umfassen würde. Die kätzchenartigen männlichen Blüthen der *Pinus*-Arten sind von einer ziemlich bestimmten Anzahl von Knospenschuppen umgeben, die z. B. bei *P. sylvestris* aus 3, bei *P. cembroides* und *P. Canariensis* aus 4, bei *P. Austriaca* aus 8–12 besteht, u. s. w. Bei *P. resinosa* und *P. Canariensis* sind diese Schuppen in der Mitte gegliedert.

IV. THE AMERICAN JUNIPERS OF THE SECTION SABINA.

From the Transactions of the Academy of Science of St. Louis, Vol. III., pp. 1–10 of reprint issued in Dec. 1877.

The species of our Junipers, are, on the whole, well enough recognized, but their scien- [583 (1)]
tific definition is very insufficient — the characters given in the books, vague and indefinite.

I have had a good opportunity to study the different species and forms from all parts of our country, fresh and living as well as preserved in numerous collections; among them those contained in the great Herbaria of New York and Cambridge (Torrey and Gray) and those of Kew (Hooker), and especially those of Berlin, whence the types of the different Mexican species were sent to me by my late excellent friend, Alexander Braun.

With the exception of *Juniperus Sabina*, which with us is always a prostrate plant, all our species occur both in the form of low shrubs and of trees, a few of them of magnificent dimensions. In the arid mountain regions, the trunks of the different species which occur there frequently assume peculiar conical forms, very thick at base and rapidly tapering to a slender point.

The bark is in most species thin, fibrous, and at last detached in shreds; only in *J. pachyphlœa* it is 1–3 inches thick, cracked like that of some oak or chestnut, the surface at last peeling off in thin layers.

The wood is fine-grained and compact, but not always hard; its growth is very slow, so that trees of 200 years have a diameter of 4–6, or, in the species growing in more generous soil and a more favorable climate, of 12–18 inches. Therefore, when we hear of mountain forms (necessarily of slow growth) having near their base a diameter of 3 feet, we cannot help estimating their age[1] at a thousand years and upwards. In *J. occidentalis* the annual rings are often quite eccentric. The resin is confined to the cambium layer and the inner bark; the wood is quite free from it but extremely durable, and, at least in *J. Virginiana*, almost indestructible. In this species the heartwood is red (hence the name *Red Cedar*) and very aromatic, soft, and splitting [584(2)] easily; in *J. Bermudiana* it is said to be similar but harder; in all the others, the wood of which I could examine, it is paler red or yellowish, harder and less fragrant; they split less readily, but are, in the regions where they abound, not rarely the most available and highly esteemed firewood.

The leaves of young plants or of vigorous shoots are, it is well known, acicular and arranged in alternating whorls of threes (rarely in twos), quite similar to the permanent leaves of the *Junipers* of the section of *Oxycedrus*, but the older and especially the fertile plants have very short, mostly closely imbricate, almost scale-like leaves, the lower part more or less adnate to and forming part of the branchlet itself. These leaves occur in some species in pairs, in others usually in threes, so as to form 4-sided or 6-sided branchlets, but this arrangement is not constant and ought not to be much relied on for specific characters. The leaves bear their stomata on the concave, upper, appressed side; the lower, convex side or back has no stomata, but is marked by a more or less distinct, either prominent or sunken "gland," as it is called,—the dorsal and only resin-vesicle or duct of the leaf. This is globose or oblong according to the shape of the leaf, or rarely (in *J. Bermudiana*) elongated, and lies in some close to the epidermis, or is in others separated from it by a layer of parenchymatous cells. The contents of this resin-vesicle are in some species or in some localities excreted through the epidermis, and are apt to appear on the back of the leaves as an aromatic balsam, and, later, as condensed resin.

The edges of the leaf are rarely entire, mostly delicately denticulate, or irregularly fringed with minute, corneous, often curved processes. This character permits us to distinguish species where others may fail.

[1] This is also alluded to in a letter received, after the above was in type, from Sir J. D. Hooker, who had just returned from an exploration of our western mountain regions, in which he speaks of the "stupendous age" of their Junipers, meaning probably *J. occidentalis*.

In the figure the form and proportions of the leaf-margin of the different species is represented as it appears when magnified 280 times; but a much lower power, even a good glass, in a favorable light, will enable the student to recognize its character. The figures show that only *J. Virginiana* and *Bermudiana* have entire leaves, while *J. Californica* has the most marked fringe; the other species are intermediate between these extremes.

Of the Old World *Sabinæ* which I have examined, only *J. Chinensis* (cultivated speci- [585 (3)]
mens) is in this respect similar to *J. Virginiana; J. fætidissima* (coll. Hohenacker) has the strongest dentation, somewhat like Fig. 2, but with more erect teeth; *J. phœnicea* (from Italy) and *J. thurifera* (from Spain) are less marked, more like Fig. 3, and *J. excelsa* (coll. Kotschy) still less so, somewhat like Fig. 4, and only a little more than *J. Sabina* (from Switzerland), Fig. 7.

The species of *Sabina* are subdiœcious, or more commonly diœcious; no specific characters can be founded on these peculiarities.

The male FLOWERS (*vulgo* aments) and fe- [586 (4)]
male aments have, like the peduncles, and in continuation of them, binate or ternate scales; the edge of the anther-scales corresponds in its character to the margin of the leaves of the same species; the number of anther-cells varies from 4 to 8 on each scale, more in the robuster, less in the slenderer forms.

The juicy strobil, GALBULUS, which we may for shortness' sake designate by the popular name of *berry*, matures like the fruit of many oaks and of the true pines in the second year, but, unlike them, it attains almost its full size in the first autumn, when even the stony coating of the seed is pretty well formed; but it matures fully a year later. We often observe berries of both years, young and maturing ones, on the same stock; but where it bears only every other year, as conifers often do, fruit of one season and of one state of maturation only is found at one time. The berry is generally closed, but in some species (I have seen it in *J. Mexicana*, *J. occidentalis*, and *J. tetragona*) it occasionally — on certain trees almost always — remains open at top, with protruding seeds.

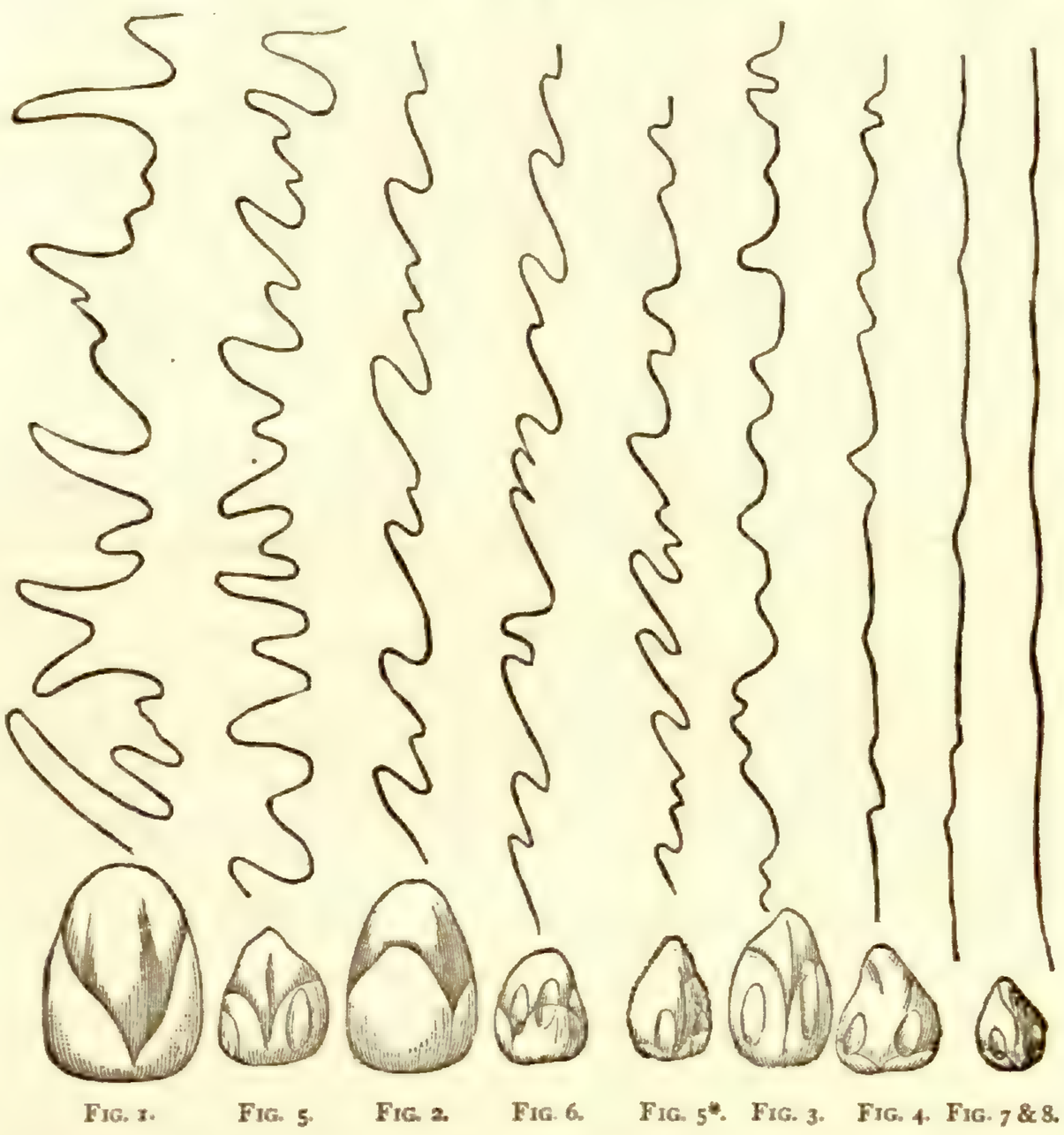

FIG. 1. FIG. 5. FIG. 2. FIG. 6. FIG. 5*. FIG. 3. FIG. 4. FIG. 7 & 8.

Margins of the leaves magnified 280 times, and seeds twice the natural size: Fig. 1. *J. Californica;* 2. *J. Mexicana;* 3. *J. pachyphlœa;* 4. *J. flaccida;* 5. *J. occidentalis;* 5*. *var.? conjungens;* 6. *J. tetragona;* 7. *J. Sabina;* 8. *J. Virginiana* and *Bermudiana*. On the seeds the impressions made by the resin-vesicles and the pale bilobed hilum are distinctly visible. The seed under Fig. 7 & 8 is the same in both.

The berry is always full of resin receptacles, mostly close to the seeds, often leaving longitudinal impressions on their surface, giving them a grooved appearance. In some species the berries are larger, drier, of a reddish-brown (when fresh, reddish glaucous) color, fibrous texture, and sweetish taste, the resinous matter — present in the immature berry — having apparently mostly been

changed into sugar;[2] in other species they are black with a blue bloom, smaller, more pulpy, and retain to a great extent their resinous contents unchanged. These differences in the berries may be used to divide the species into two groups, while form and arrangement of leaves are unavailable for this purpose.

The SEEDS vary in number; in some species they are single or sometimes in twos, rarely in threes, while in others the number rises from 5 to 10 or even 12, of which some usually remain imperfect. The seeds have a hard, stony coating, often of great thickness, ovate in general outline, smooth, or grooved or angled and variously compressed, and sometimes rough or tubercled; they are brown and shining upwards, and are marked below with a larger or smaller, mostly [587 (5)] bilobed, pale hilum. I cannot discover that the shape of the seeds, the presence or absence of the grooves or impressions, or the roughness of the surface, has much specific value.

The embryo of most species has two cotyledons; only in *J. Californica* I find regularly more (4–6, mostly 5) cotyledons, — a curious repetition of a constant character of *Abietineæ*, and perhaps the only instance of it in *Cupressineæ*. Marked as this peculiarity is, it is not accompanied by any other character which would justify us in separating this species generically from its allies.

The GEOGRAPHICAL DISTRIBUTION of our Junipers is an interesting and, at least in regard to one of the species, an abnormal one. Most of the Junipers are rather local. Three species (*J. Mexicana, flaccida, tetragona*) are confined to the highlands of Mexico, and one (*J. Bermudiana*) to several West Indian Islands. Among those within our boundaries, one (*J. Californica*) is peculiar to the coast ranges and islands of California, and another one (*J. pachyphlœa*) to the interior of Arizona and New Mexico, into which and into Utah a variety of the former also extends. Another species, properly named *J. occidentalis*, is characteristic of the whole western mountain region from West Texas, New Mexico, and Colorado, as far as California and Oregon.

Then there is the northern *J. Sabina*, which, as well as *J. communis*, of which we do not treat here, follows the laws of high northern, or, as it is called, circumpolar distribution, extending from Maine and Nova Scotia along the Great Lakes and to British Columbia as well as through Northern Asia and Europe, *J. Communis* reaching down to lower latitudes than the other, especially in the mountain ranges.

Thus far all our species have not deviated in their distribution from the well-known laws of geographical botany. But one species, our common Red Cedar (*J. Virginiana*), makes a remarkable exception. It is the only conifer and one of the very few trees[3] which are found east as well as west, and certainly the only one which at the same time extends through so many [588 (6)] degrees of latitude. It is well known from the St. Lawrence to the Cedar Keys of Florida, from the Atlantic to the Rocky Mountains; and farther, even to the Pacific coast of British Columbia.

I arrange the nine American species in the following order: —

I. SABINÆ, with larger, reddish-glaucous, fibrous, dry, sweetish berries.
  A. Seeds single or few; leaves fringed or denticulate.
    a. Cotyledons 4–6.
  1. *J. Californica.*
    b. Cotyledons 2.
  2. *J. Mexicana.*
  B. Seeds numerous, 4–12; leaves slightly denticulate.
  3. *J. pachyphlœa.*
  4. *J. flaccida.*

[2] I have been able to examine the fresh fruit of only *J. Californica* and *pachyphlœa*, but have little doubt that that of the other two species, referred here, is of the same character. A similar process seems to take place in the sap of the sugar-pine, *Pinus Lambertiana.*

[3] The others belong to the universal poplars, and may perhaps as well be classed among the circumpolar vegetation extending south along the mountains.

II. SABINÆ, with smaller, bluish-black (rarely brown) pulpy berries, of resinous taste.

A. Leaves ciliate or denticulate.

5. *J. occidentalis.*
5*. *J. conjungens.*
6. *J. tetragona.*

B. Leaves entire or nearly so.

7. *J. Sabina.*
8. *J. Virginiana.*
9. *J. Bermudiana.*

1. J. CALIFORNICA, *Carrière:* A stout shrub, or small tree (rarely 20 to even 35 feet high) with stout branches, the branchlets perhaps the thickest of any *Sabina;* leaves almost always in 3's, in young shoots acerose, white above, in adult plants, even on the thicker branches, closely appressed, short and thick, rounded at tip, distinctly cartilaginous-fringed on the margins; anther-scales (18–24) mostly in 3's, rhomboid, scarcely acute; scales of female ament usually 6, spreading; berry globose or mostly oval, 5–6 lines long, with scale-tips scarcely prominent; seeds 1 or sometimes 2, 4–6 lines long, with a very thick and hard shell, smooth, shining brown above, with large bilobed whitish hilum. — Rev. Hort. 3, 352 (1854); Conif. 58. *J. tetragona*, var. *osteosperma*, Torr. Bot. Whipp. in Pac. R. Rep. 4, 141; Bot. Mex. Bound. 210. *J. Cerrosianus*, Kellogg, Proc. Calif. Acad. 2, 37, fide spec. auctoris in Herb. Torrey. (See Fig. 1.)

Var. UTAHENSIS: In all the parts smaller, leaves and tips of fruit-scales often in pairs, fringe of leaf-margin shorter; berries more commonly globose; seeds mostly single, smaller.

California, from San Francisco (Monte Diablo) southward, principally on the Coast range and on the Islands; the variety all over the southern parts of Utah and into Arizona and Nevada. — Bark shreddy, wood pale; about St. George, Utah, where the variety furnishes the common fire-wood, it is a small tree 20 feet high; [589 (7)] berries smaller, 3–5 lines long; cotyledons same as in the species, never less than 4. Dr. Palmer has sent from the Colorado River a form with whitish, scaly bark, which I cannot otherwise distinguish, but have seen no mature fruit of it. — The plant is often confounded with the stouter forms of *J. occidentalis*, but in fruit can always be readily distinguished.

2. J. MEXICANA, *Schlechtend.:* A bush or (fide Parlatore) a pyramidal tree; spray much more slender than the last, older branchlets with semi-acerose, squarrose leaves; leaves of ultimate branchlets mostly in pairs, slender, acute, irregularly denticulate; anther-scales in pairs (about 12) strongly cuspidate or almost acuminate; scales of female ament about 2 pairs, spreading, rarely in 3's; berry globose or oval, as large as and similar to that of the foregoing species; seeds single or often 2 or 3, similar to the last. — Linnæa 5, 77 (1830); ib. 12, 494. Parlat. in DeProd. 16, 2, 491. (See Fig. 2.)

Mexico. — The 1-seeded form is Schlechtendal's original, sent by *Schiede* from Llanos de Perote; Real del Monte, *Hartweg*, 433. A 2–3-seeded form has been collected at the last locality by *Ehrenberg* (often with protruding seeds) and *Gregg*, 636; in the Sierra Madre, *Seemann*, 2001; Cosiquiriachi, *Wislizenus*, 230. — Most collectors describe this species as a bush or small tree, but Parlatore assigns to it, without giving his authority, a height, sometimes, of 70–90 feet; he gives the bark as *secedens*, shreddy. The slender branchlets, the acute, denticulate, not deeply fringed leaves spreading on the older branchlets, and the regularly 2-cotyledonous embryo, distinguish it readily from the last.

3. J. PACHYPHLŒA, *Torr.:* A middle-sized tree with a spreading, rounded top, thick and much cracked bark and pale reddish wood, closely allied to the last, with the same squarrose leaves on the stouter branchlets, but distinguished by the slenderer, acuter, less prominently denticulate or ciliate leaves, usually in pairs, and by the obtusish anther-scales; berry globose or irregularly tubercled, 5–6 lines thick; seeds mostly 4, angular. — Bot. Whipp. in Pacif. R. Rep. 4, 142 (1857); Bot. Mex. Bound. 210; Parl. l. c. 490. *J. plochyderma*, Sitgr. Rep. (1853), tab. 16, spalm.; Parl. l. c. 492. (See Fig. 3.)

New Mexico and Arizona, *Woodhouse, Parry, Wright, Coues, Palmer, Greene.* — Further examination must show whether it stands not too close to the last; but the character of the bark seems to distinguish it completely from that and any other species. In the report of Sitgreave's Expedition, p. 12, this singular species is mentioned, and on page 173 Torrey gives a short account of this and two other forms, without naming them. The plate with the name of *J. plochyderma*, probably a mistake of the lithographer for *pachyderma*, gives a rough figure of our tree.

4. J. FLACCIDA, *Schlechtend.:* A bush, or small or middle-sized tree with shreddy bark, with spreading branches and slender, nodding branchlets; leaves always in pairs, acute with spreading tips and slightly denticulate margins; male flowers quadrangular, narrow, consisting of 16–20 keeled cuspidate anther-scales; large (6–7 [590 (8)] lines thick) globose or often irregularly tubercled berry, mostly with recurved acute scales, containing 8–12 seeds in several tiers; seeds small, much distorted, many of them abortive. — Linnæa 12, 495 (1838); Parlat. l. c. 492. (See Fig. 4.)

Mexico, *Ehrenberg* and others ; *Coulter*, 1419 ; Saltillo, *Gregg*, 432, a shrub, 10 feet high. — Well distinguished by its slender branchlets and acute, mostly somewhat spreading leaves.

5. J. OCCIDENTALIS, *Hook.* : A shrub, or mostly a small tree (in Oregon of the largest dimensions) with shreddy bark and pale reddish-yellow wood ; closely appressed leaves in 3's or often in pairs, obtuse or acutish, delicately fringed on the edges ; anther-scales obtusish or short-cuspidate ; berries 4–5 lines in diameter, with 1 or more seeds. — Hook. Fl. Bor. Am. 2, 166 (1840) ; Parl. l. c. 489. (See Fig. 5.)

Var. *α.* PLEIOSPERMA with straighter, stouter branchlets, leaves almost always in 3's ; berries larger (4–5 lines diam.), very resinous, deep black-blue, with 2–3 much grooved seeds. — *J. excelsa*, Pursh. Fl. 2, 647, not M. Bieb. *J. Andina*, Nutt. Sylv. 3, 95, t. 110.

Oregon to the higher mountains of California, in the north sometimes a large tree (*Lewis, Douglass, Newberry*), generally smaller or bushy ; if without fruit, it is not always easily distinguished from *J. Californica*, which Parlatore unites with it ; the margin of the leaf is much like that of var. *Utahensis* of that species, but the fruit is very different.

Var. *β.* MONOSPERMA, a shrub or small tree, often with eccentric layers of wood (Cañon City, Colorado), of scraggy growth, with short branchlets at right angles ; leaves as often in 2's as in 3's ; berries smaller, with 2 or more, commonly only 1, less grooved seed.

From the Pike's Peak region of Colorado through West Texas and New Mexico to Arizona and California, where var. *α.* takes its place. — In Colorado the berries are often copper colored, as Parlatore describes those of the species, and in some trees the seeds protrude.

Var. ? *γ.* CONJUNGENS, a bush or tree 20–40 feet high, often with eccentric layers of wood ; branchlets slender, with 4-ranked, obtuse, closely appressed, slightly denticulate leaves ; anther-scales obtuse or slightly cuspidate ; berries globose, 3–4 lines thick, with 1–2 smooth or more or less tuberculate seeds. (See Fig. 5*.)

West Texas, where it forms forests and is an important timber tree, "although not as large nor as easily worked and useful as the red cedar of the plains of Eastern Texas" (F. Lindheimer). *Berlandier*, 671, 2081 ; *Lindheimer, Wright, Bigelow, Hall.* — Mr. Chas. Wright found in the damp rocky woods of the mountains of Eastern Cuba a few individuals of a middle-sized tree, apparently very rare, of which only male specimens were obtained (Pl. Cub. 3187, *J. Virginiana*, Griseb. Pl. Cub. 217), which without fruit I cannot distinguish from this Texan form ; what I take to be the same thing, has been sent from Mexico by Sartorius in Hb. Torrey, and by Aschenborn from Zimapan, 381, in the Berlin Herb. ; the latter with small 1-seeded berries. — This form connects the northwestern [591 (9)] *J. occidentalis* with the southern *J. tetragona*, so that it is sometimes difficult to clearly separate them.

6. J. TETRAGONA, *Schlechtend.* : A low bush with spreading branches and thick sharply quadrangular branchlets; leaves closely appressed, obtuse, strongly keeled, distinctly denticulate ; anther-scales obtusish, short-cuspidate ; berries globose, dark blue-black (4–5 lines thick), 3–5 seeded, seeds angular and more or less grooved or pitted.— Linnæa 12, 495 (1838) ; Parlat. l. c. 491. (See Fig. 6.)

Var. OLIGOSPERMA, a bush or low tree ; berries smaller, with 1 or 2 more regularly formed seeds.

Mexico, Real del Monte, *Ehrenberg, Hartweg*, 436, *Uhde ;* Orizaba, *Linden.* — A low shrub 3–6 feet high. The variety from Saltillo, *Gregg*, 106 & 398, 10–30 feet high, with seeds somewhat similar to var. ? *conjungens* of the last species, and occasionally protruding, but with stouter branchlets.

7. J. SABINA, *L.* ; var. PROCUMBENS, *Pursh.* : A prostrate shrub with appressed or slightly squarrose acute leaves in pairs, margin slightly or indistinctly denticulate ; anther-scales obtusish, nearly entire ; berry on short recurved peduncles, 3–4 lines in diameter, with 1 or 2, rarely 3, often rough seeds. — Fl. 2, 647 (1816) ; *J. Sabina*, Michx. Fl. 2, 246 ; Parlat. l. c. 484 ; *J. prostrata*, Pers. Syn. 2, 632 ; *J. repens*, Nutt. Gen. 2, 245 ; *J. Sabina, β. humilis*, Hook. Fl. Bor.-Am. 2, 166. (See Fig. 7.)

From Maine and New Brunswick to the shores of the Great Lakes and northward to the Hudson Bay regions ; westward to the Yellowstone River and to British Columbia and the Pacific coast. — Michaux as well as Hooker seem to indicate that northward the ordinary form of *J. Sabina* is also found, but I have seen no specimens ; the plants from the localities given above are all prostrate, spreading over and closely carpeting sandy shores and rocks with stems up to 1 inch or more in thickness, with red heartwood and brown scaly, scarcely shreddy bark ; the branches extend 6–10 feet or more ; branchlets often covered with subacerose leaves, and sometimes even bearing fruit in that state ; but generally the fertile plants have the short, appressed leaves common to the whole section. Mr. H. Gillman — late of Detroit, now in Waldo, Florida — who has very attentively studied the Flora of the Upper Lake country, found the branches usually flattened, and with eccentric annual rings. He observed that where they recline on rocky soil, the lower part, touching the rock, is rubbed off, or the formation of wood there prevented ; but where they spread over fine sand, the lower side is protected and the upper surface undergoes a similar process through the friction of wind-driven sand. He occasionally found berries even 5 lines thick, containing as many as 4 seeds.

8. J. VIRGINIANA, *L.* · The largest, the widest spread, and the most useful of our American Junipers, commonly of pyramidal form, with shreddy bark and red and aromatic heartwood ; slender 4-angled branchlets, with opposite

obtuse or mostly acutish leaves with entire margins; anther-scales 10–12, rounded, entire, each bearing [592 (10)] usually 4 or sometimes 6 anther-cells; berries on straight peduncles, 1–2-seeded; seeds angled, mostly groove l, and often rough toward the upper end. — Spec. Pl. 1471 (1753); Parlat. l. c. 488. (See Fig. 8.)

From the St. Lawrence to Florida and from the Atlantic to the Northern Pacific; it is not found in Southern Texas, in the greater part of Utah and Arizona, and in the whole of California and perhaps Oregon; in Washington Territory and British Columbia it associates with *Sabina* and perhaps with *occidentalis*, and in the Rocky Mountains south of Pike's Peak with the latter species; on the Upper Missouri (Cedar Island) it attains large dimensions. — Usually the berries are small, about 3 lines thick, but in the Rocky Mountains forms occur with berries of 4 or 5 lines in diameter, and with larger seeds; among the foot-hills of Pike's Peak the trees of this species have the size and shape of an apple tree, with a rounded, spreading top.

9. J. Bermudiana, *L.:* A tree said to have been common on the Bermudas, and also in other West Indian Islands, of which I have seen only a few specimens. Branchlets stout; leaves in pairs, oblong or linear-oblong, obtuse, closely appressed, with entire margins and a well-marked linear gland or resin-duct on the back; anther-scales about 16, large, rounded, smooth-edged, with about 6 cells; berry with 2–4 seeds, much like those of the last species. — Spec. Pl. l. c.; Parlat. l. c. 490. (See Fig. 8.)

J. Barbadensis, L.: is said to be the same species, and *Biota Meldensis*, Gord. its acerose young state. Michaux, as well as Parlatore, quotes Florida as its home, but all the specimens from that country which I have seen, even those from Cedar Keys, and those of Michaux's Herbarium in Paris under the name of *J. Barbadensis*, are nothing but forms of *J. Virginiana*, with very small, rounded, and strongly convex leaves. The forms from the different West Indian Islands, all referred to *J. Bermudiana*, require further examination, as we know that one at least, from Cuba (see p. 590), is certainly quite different from it.

V. A SYNOPSIS OF THE AMERICAN FIRS (*Abies*, Link).[1]

From the Transactions of the Academy of Science of St. Louis, Vol. III., pp. 1–10 of reprint issued in 1878.

Great confusion prevails in regard to the distinction of species of our Firs and in their [593 (1)] synonymy. This is owing partly to the innate difficulty of the subject and to the very imperfect descriptions in the books, and partly to the inordinate zeal of seed collectors and horticulturists. But in the last decade the western mountain regions, the homes of most of our firs, have been more fully explored, and the geographical limits of the species ascertained; and in about the same period the anatomical structure of their leaves has been investigated, and has furnished welcome aid in the distinction and the classification of the species.

It is a most interesting as well as significant fact that while the anatomical structure of the leaves of higher organized plants shows considerable uniformity, so that it rarely can be made available for diagnostic purposes, the conifers exhibit such a wonderful variety of leaf-structure (approaching thereby the lowest orders of vascular plants), that often a single leaf is sufficient to recognize the genus, and often the species, even when the ordinary characters may leave us in doubt.

The anatomy of coniferous leaves has been often examined into, but the first to appreciate their characters as a means of classification was F. Thomas, who in 1865 published an extensive treatise on the subject in Pringsheim's *Jahrb.* 4, pp. 23–63. He was followed in 1871 by C. E. Bertrand, *Bull. Soc. Bot. France*, 18, pp. 376–381. The same author gave a more elaborate paper on this sub-

[1] I follow Link (*Linnæa*, 15, 525, 1841) in his name, definition, and circumscription of the genus, which seems to be a very natural one, comprising the silver or balsam firs. The synonym *Picea* Don, in *Loudon Arb.* 4, 2329, 1838, is the older name and enjoys the Linnean prestige, but is contrary to classical (Plinius, etc.) and philological authority. The name *Abies* is generally adopted on the continent of Europe, while *Picea* was heretofore principally used in England, but is now being abandoned. *Picea* Link (the same as *Abies* Don) is the proper name for the spruces. Tournefort, the elder DeCandolle, Gray, and others comprise under the name of *Abies* both firs and spruces. The generic distinctions between them are based both on the floral and fruit characters as well as on the leaf anatomy.

A reprint of this paper will be found in the *Gardeners' Chronicle*, n. s., Vol. IX. pp. 265–266, 300, 334. — Eds.

ject in 1874, in *Ann. Sci. Nat. Bot.*, 20, pp. 5–153, with 12 plates. He was followed in the succeeding year by W. R. McNab in *Proc. Irish Acad.*, 2, pp. 209–213, with 1 plate; and in [594 (2)] 1877 the same published an exhaustive paper in the same Journal, pp. 673–704, with 4 plates. E. Purkinje, of the Foresters' Academy of Weisswasser in Austria, made, four or five years ago, extensive investigations on the same subject, but has, I believe, not yet given his results to the public. My own studies in this line, commenced some fifteen years ago, when the conifers of the Rocky Mountains first got into the hands of botanists, have been carried on more assiduously within the last three years.

Highly important as the microscopic investigations of the leaf anatomy are, they have sometimes been relied on too exclusively, disregarding the characters furnished by the reproductive organs.[2]

It may not be useless to repeat that the leaves of all firs are sessile with a circular base (leaving a circular scar in falling off), and without the prominent persistent ligneous cushion which is peculiar to the spruces. They are usually more or less flattened, grooved above and keeled below, and those of the branches are mostly twisted above the base so as to give them a more or less distichous direction; the leaves of the erect shoots are thicker and convex above, and not twisted. The tip of the leaves of young trees, and of the lower branches of older ones, is notched in almost all species; the leaves of robust shoots and of fertile branches are mostly entire, obtuse in some, acute in others.[3] All the leaves have stomata on the under side, arranged in a smaller or larger number of series, forming bands on each side of the keel. On the upper side of the leaf stomata are present in some, especially in those with thicker leaves, and absent in other species, mostly in those with flatter leaves; in several species the leaves of the lower or sterile branches are without stomata above, and the thicker ones of the upper or fertile branches have a few (in the upper part of the groove) or many. The thick epidermis of the upper surface is mostly underlaid and strengthened by very robust longitudinal cells, with thick walls and a very slender cavity, which have been named [595 (3)] pseudo-bast cells, but are now generally known as hypoderm cells. They are almost always present on the edges and the keel of the leaf, there sometimes crowded in 3–5 layers, and they often form a more or less interrupted stratum on the upper side. Where stomata pierce the epidermis, the hypodermic stratum is incomplete, or entirely absent. Only in a few species (*A. bracteata* and *religiosa* and the Asiatic *firma*) we find such cells also in the interior of the leaf, a case which is common in true pines. In some species the diameter of these cells is equal to that of the epidermis cells; in some it is smaller, and in a very few larger. Their presence, distribution, and relative size is tolerably constant, and furnishes good specific characters.

I do not describe the parenchymatous cells containing chlorophyll, nor their variety the so-called palisade cells (elongated cells perpendicular to the upper side of the leaf), as no essential characters are derived from them. But of great diagnostic importance are the resin-ducts, of which there are always two in the Abies leaf, readily seen in a horizontal section. In some species they are placed on the lower side of the leaf, close to the epidermis and mostly near the edges; in others we find them in the parenchyma, about equidistant from the upper and lower surface.

The fibro-vascular bundle occupies the centre of the leaf, either single (in the more square leaves of the 4th section), or mostly divided in two distinct bundles (in the flat leaves). Both cases occur sometimes in the same species. The bundles show the larger (ligneous) cells above and the smaller (bast-) cells below; they are surrounded by small pith-like cells, and the whole separated from the parenchyma by a sheath of larger cells.

[2] The separation by Bertrand, followed by McNab, of *Abies nobilis* from the other firs, and the connecting it with *Pseudotsuga Douglasii*, notwithstanding their striking differences in pollen, fruit, and seed, must be considered as the result of such one-sided investigation.

[3] Hence the necessity of collecting, if possible, branches of a young tree, erect shoots, lower branches of older, fertile trees (the only specimens which we usually find in Herbaria, because easily attainable) and branches with male and such with female flowers, or with their vestiges; besides these, the cones and seeds and young seedling plants are important. A slice of the bark of old and of young trees ought to complete the material.

On the differences of the leaf-structure we can base the subdivisions of the genus with much greater certainty than on the length of the bracts, as was formerly done.

Sec. I. BALSAMEÆ : Resin-ducts within the parenchyma, in the interior of the leaf ; leaves on lower branches notched, and mostly without stomata on the upper side, on fertile branches entire, obtuse, or often acute, mostly with a few or more stomata above, towards the tip. — Two eastern and one northwestern species.

* *Exserta :* bracts protruding, recurved.

1. *A. Fraseri.*

* * *Inclusæ :* bracts shorter than the scales. [596 (4)]

2. *A. balsamea.* 3. *A. subalpina.*

Sec. II. GRANDES : Resin-ducts close to the epidermis of the lower side, toward the edges ; leaves on lower branches notched or obtuse ; on upper, obtuse, rarely ever acute ; bracts enclosed. — Two western species.

4. *A. grandis.* 5. *A. concolor.*

Sec. III. BRACTEATÆ : Resin-ducts as in last ; upper side of the rigid, mostly acute leaves without stomata, with a continuous layer of hypoderm cells, usually similar cells within the sheath of the fibro-vascular bundle ; pallisade-parenchyma very strongly developed ; bracts exsert. — A Mexican and a southwestern species.

6. *A. religiosa.* 7. *A. bracteata.*

Sec. IV. NOBILES : Leaves of the adult tree and especially of the fertile branches quadrangular, short, curved, but scarcely twisted ; resin-ducts close to the epidermis of the lower side, and equidistant from the edge and keel ; fibro-vascular bundles single ; stomata on both sides ; leaves of young trees much like those of Sec. II. — Two species of the higher mountains of the Pacific slope.

* *Exserta :* bracts protruding.

8. *A. nobilis.*

* * *Inclusa :* bracts shorter than scales.

9. *A. magnifica.*

1. A. FRASERI (*Pinus,* Pursh. Fl. 2, 639, 1816 ; Parlatore in DC. Prod. 16, 2, 419), Lindl. Pen. Cyc. 1, No. 5 (1833), Forbes, Link, etc. This is probably the most local species in the United States, being confined to the tops of the highest mountains of North Carolina, which have an altitude of 6,000 feet or more, and the tops of which it covers together with some *Picea nigra,* but it never occurs mixed with the following species. — A small tree rarely as much as 30 or 40 feet high, and 12 or 18 inches in diameter, probably never more than 60 to 75 years old, with cinnamon-brown smoothish bark ; readily distinguished from *balsamea* by the shorter, more oval cones with largely exsert and reflexed bracts, and always, even when sterile, by the almost uninterrupted stratum of hypodermic cells on the upper side of the leaf, more crowded on the edges. The white bands on the under side of the leaf consist usually of 8 or 10, or even 12 series of stomata ; height of scales (without the stipe) equal to one-half or two-thirds their width ; length of seeds equal to length and width of wing. — Forms of the next species with exsert tips of bracts, in the mountains of Pennsylvania, Vermont, and other northern regions, seem to have been mistaken for this species. In eastern as well as in European gardens forms of *balsamea* are often cultivated under the name of *Fraseri.*

2. A. BALSAMEA (*Pinus,* L. Sp. Pl. 1421, 1753 ; Parl. l. c. 423), Marshall Arb. Am. 102, Link, etc. [597 (5)] *A. balsamifera,* Michx. Fl. 2, 207, in part. — The northeastern "Balsam" extends from Canada and the northeastern States along the mountains to Virginia, and along the Great Lakes to and beyond the Mississippi. It is a larger tree than the last, often 70 feet high, 1½ feet in diameter, and up to 150 years old ; bark smooth, and reddish-gray when young, brown and much cracked in old trees. Its slenderer cones with enclosed bracts (only their points sometimes protruding), and especially the leaves with scarcely any hypoderm cells above and very few on edges and keel (fewer than in any other of our species and sometimes none) and with narrower bands of stomata below (of 4–8, usually about 6 series), readily distinguishes it. *A. Hudsonia* of the gardens, often considered as a form of *Fraseri,* is a sterile dwarf form of *balsamea,* found also on the White Mountains of New Hampshire above the timber line.

* 3. A. SUBALPINA, Engelm. in Am. Naturalist, 1876, p. 555. *A. lasiocarpa,* Hook. Fl. B. A. 2, 163. ? *A. bifolia,* Murr. Proc. R. Hort. Soc. 3, 318. *A. amabilis,* Parl. l. c. 426, in part. — Closely allied to the last species, the western representative of which it must be considered to be ; it extends from the higher mountains of Colorado and the adjoining parts of Utah northward to Wyoming and Montana, where it is the only species, and westward to the mountains of Oregon and into British Columbia (Fraser's River) and southward probably to Mount Shasta, always scattered in

* This description is reprinted in the *Gardeners' Chronicle* for Feb. 19, 1881, p. 236, where figures from photographs sent by Dr. Engelmann are published. — EDS.

the subalpine forests, and, at least in Colorado, coming up almost to the timber line, but never alone constituting forests. It is a larger tree than *balsamea*, often over 2 feet in diameter and 60–100 feet high, with thin, pale whitish, smooth bark, which only in very old trees becomes cracked and ashy-gray ; timber so poor and soft that in some parts of the Rocky Mountains it is called pumpkin pine. Leaves like to those of *balsamea*, notched on sterile and pointed on fertile branches ; hypoderm considerable, though interrupted on upper surface, crowded on edges and keel. Cones retuse, brown-purple, 2–3½ inches long, 1–1¼ inches in diameter, the smaller ones near the timber line. Scales rounded or almost square, often almost as high as broad, similar in their proportions to those of *balsamea*, but larger ; bracts short, emarginate, mucronate ; seeds, including the wing, over 1 inch long, the latter nearly twice as long as it is wide.

Var. FALLAX has the resin-ducts of this species, but the foliage almost of *concolor ;* leaves sometimes 1½ or even 1¾ inches long, mostly obtuse, and covered with stomata above, glaucous when young. — Dr. Newberry's specimen in the Herb. Agricult. Dep. Washington, collected on the higher tops of the Cascades, south of the Columbia River, and described [4] by him as *A. amabilis* in Pac. R. Rep. 6, bot. 51, belongs here ; the loose scales (12 [598 (6)] lines wide, 11 high, with pointed bracts, seed with narrow wings, as in the species, but larger) brought home indicate a large cone, such as he describes as 6 inches long and 2½ thick. S. Watson and lately A. L. Siler collected a similar form on the Wahsatch Mountains; but the loose broad scales sent by the former may possibly belong to *concolor*, which grows in the same region. The mere fragments of this interesting form, seen by me, do not permit me to give more than the above indications.

This species has troubled botanists considerably. It is probable that Hooker's *lasiocarpa* belongs here, as a branchlet together with a few scales, preserved under that name in the Kew Herbarium, seems to point out ; but the description in the Flor. B. A., which mentions the leaves as the longest of any N. A. *Abies*, refers perhaps to something else, and has certainly given cause for the application of the name to the long-leaved forms of *concolor* in the English nurseries. Then, in 1863, A. Murray distinguished a form of this species, collected by Lyall in British Columbia and on the Upper Columbia River, as *A. bifolia*, recognizing the different forms of foliage, but misapplying the scientific name. About the same time specimens and seeds from Colorado were distributed by Dr. Parry and by E. Hall as *A. grandis*, and may now be cultivated as such in Europe. That Parlatore and others have taken it for *amabilis* has already been stated.

4. A. GRANDIS (*Pinus*, Douglas mss., 1830, and in Bot. Mag. Comp. 2, 147, 1836 ; Parl. l. c. 427), Lindl. Pen. Cyc. n. 3 (1833), Link, etc. — This is one of the tallest firs known and therefore properly named *grandis* by Douglas, a tree up to 200 and frequently 240 (Nuttall) or even 300 feet high (E. Hall), but in diameter less than some others, perhaps not more than 4 feet ; bark smooth and brownish (Nuttall) ; wood white, soft and coarse ; a native of the littoral regions of the northwest coast, from Cape Mendocino in California, *Bolander*, *Vasey*, which seems to be the southern limit of several northern trees, to the British Possessions (in Vancouver Island as *A. Gordoniana* Carr.) at least as far north as Fraser's River, *Jeffrey*, *Lyall*. But, common and valuable as this timber tree is in Oregon, very little information about it has reached us, and its cones seem to be almost unknown in collections. — The foliage is glossy green, without stomata above, and with 2 well-marked white bands, each of 7–10 rows below ; leaves mostly 1–2 inches long, more markedly distichous, at least in the sterile branchlets, than in most other of our species, strongly grooved and notched ; leaves on the fertile branchlets similar but rather shorter, and occasionally rounded at tip. The hypoderm cells are scattered all over the upper surface of the leaf, forming an interrupted stratum under the epidermis ; on the sides and keel they are, mostly, only moderately developed. Cones cylindric, 2–4 inches long, with broad scales (nearly twice as broad as they are high), and short, bilobed or 2-auriculate bracts, with or without a short mucro. Seeds with a broad, very oblique wing, almost as broad as it is long.

This species is cultivated in European gardens from Douglas's seeds, sent home forty-five years ago ; in the Edinburgh Bot. Garden under its proper name, in Dropmore Park as *A. amabilis ;* but, though now over [599 (7)] forty years old, seems not to have coned yet. In the same establishments another fir is cultivated, in Edinburgh as *amabilis*, in Dropmore as *grandis*, thus continuing the confusion which has existed from the first in regard to these names. I suspect this to be the real *amabilis* of Douglas, but take it for a variety of *grandis*, which — Douglas's name being doubtful — may be designated as —

Var. DENSIFOLIA : Foliage denser than in the species, clustered on the upper side of the branches like that of *Nordmanniana ;* leaves dark glossy green above, with 2 very conspicuous white bands below ; hypoderm cells more crowded under the upper surface of the leaf ; cones and seeds the same. — Apparently a mountain form of *grandis*, from the base of Mount Hood, *E. Hall*, mixed with *subalpina*, to British Columbia, *Lyall*. Douglas found his *amabilis* in September, 1825, "on the mountains immediately south of the Grand Rapids of the Columbia," together with *A.*

[4] His description of the foliage, however, seems to refer to what I call below *A. grandis* var. *densifolia*. Dr. N. may have mixed both forms, an unfortunate mishap which is by no means rare in such collections, mostly made in haste and often under unfavorable circumstances.

nobilis; but the cone sent home by him (at that time or later?) was a much larger one, 5–6 inches long, 2½–3 thick, with lanceolate bracts; from its seeds the above-mentioned trees are said to have sprung. Unfortunately the large cone, figured by Lambert as *grandis*, and by Loudon and in Pinet. Woburn. as *amabilis*, and formerly preserved in the collection of the London Horticultural Society, seems to have been lost since the sale of that collection; it may have been similar to Newberry's cone of *fallax*, described above.

The following species have been claimed for *amabilis: A. subalpina* is called so by Parlatore l. c., who seemed to rely on its native locality and on its leaves (or many of them) being entire, but overlooks other characters.— Var. *fallax* of that species, taken for *amabilis* by Newberry, has a large cone and similar bracts, but is not in cultivation, as Douglas's tree is supposed to be. — *A. magnifica*, the *amabilis* of the Californian botanists, has the large cones, the lanceolate bracts, and the entire leaves, claimed for *amabilis;* but the foliage is quite different, and so is its locality. — *A. nobilis:* Prof. McNab finds the leaves of the type specimen of *amabilis* in Herb. Kew identical with *nobilis* leaves; I have examined the same leaves and take them with scarcely a doubt for those of a form of *grandis*. — *A. concolor* has been named *amabilis* in some gardens. — Locally the "yellow fir" of Oregon, as *Pseudotsuga Douglasii* is often called, seems to have been also taken for *amabilis*, perhaps on account of its entire leaves.— There remains only the tree which I have designated as *A. grandis* var. *densiflora*, which, together with *grandis* itself, is the only western *Abies* (*nobilis* excepted) which has sprung from Douglas's Oregon seeds. No *subalpina, magnifica* or *concolor* has been in cultivation longer than the modern knowledge of California extends back and the influx of English seed-collectors, beginning with Jeffrey in 1851. None of these species, then, can be Douglas's *amabilis*, but every consideration points to the tree cultivated under that name in Edinburgh. Prof. McNab has come to the same conclusion, but differs from me in considering it a distinct species. Further exploration of the Cascade Mountains between the [600 (8)] Columbia River and Shasta, probably the least known mountain region of the Pacific coast, will, it is hoped, clear up these doubts.

5. A. CONCOLOR (*Pinus*, Engelm. in Herb. 1848; Parlat. l. c. 426) Lindl. in Gordon Pin. 155, 1858. Long known only from Fendler's New Mexican specimens No. 828, coll. 1847, this elegant species now proves to be widespread over the southern Rocky Mountains, from Pike's Peak in Colorado, where it occurs only in the valleys of the foothills, to the higher mountains of New Mexico, the southern parts of Utah, and the northern of Arizona, and throughout the Californian sierras, at an elevation of 3–7,000 feet, to Mount Shasta; whether in the southern Cascades, is not known. It is *A. Lowiana*, Gord. Suppl. 53; *A. grandis* of the Californian botanists; *A. lasiocarpa* of the nurseries (so called from its long leaves, which constitute a character of the original *lasiocarpa*); *A. amabilis* of some establishments (because of the large cones and obtuse leaves); *A. Parsoniana* of the gardens. It is a stately tree, in California up to 150 feet high, 3–5 feet in diameter, and 200–300 years old (Lemmon); in the Rocky Mountains not quite so large. — The bark is pale in young trees, but darker than in *subalpina*, and soon becomes rough and of an ash-gray color, in old trees often several inches thick and deeply fissured. The wood is more valuable than that of *subalpina*, perhaps equal to that of *grandis*, but much less so than the wood of *magnifica*. The tree is always readily distinguished by its pale glaucous foliage, which at last gets dull green, and by the length of the leaves of the young trees, 2–2½ and sometimes even 3 inches long — longer than in any other of our firs. Only such leaves or those of the lower branches of old trees are notched at the end; on the older trees they are shorter, very broad, convex above, usually falcate, and always obtuse; on the flowering branches they become often quite thick, keeled above, and almost quadrangular. On older trees stomata cover the upper surface; in young ones they are usually confined to the middle line of the leaf, but are never absent. Hypoderm cells are interruptedly distributed over the upper surface. Cones oblong, 2–4 or even 5 inches long, retuse, or in some trees short-pointed; usually apple-green before full maturity, but, at least in Colorado, varying to different shades of brown or purple.[5] The scales are very broad in proportion; the bracts short, rounded, or truncate, or sometimes emarginate, with, or rarely without a short mucro; wing of seed broad, as wide as it is long; cotyledons 5–7, usually 6.

6. A. RELIGIOSA (*Pinus*, HBK. N. Gen. Sp. 2, 5, 1817; Parl. l. c. 420), Schlecht. Linnæa 5, 77, 1830. — On the higher lands in Mexico, extending to Guatemala. A tall tree with linear, acute, or rarely obtuse, dark, glossy leaves; cones oval-oblong, 3–5 inches long, 1½–2 thick; bracts more or less protruding, acute or cus- [601 (9)] pidate; scales one-third wider than they are high; seed-wings longer than wide; cotyledons 5.— *A. hirtella* (*Pinus*, HBK. ib.) is scarcely a variety.

7. A. BRACTEATA (*Pinus*, Don in Trans. Linn. Soc. 17, 443, 1837; Parl. l. c. 419), Nutt. Sylv. 3, 137, 1849. *P. venusta*, Dougl. Bot. Mag. Comp. 2, 152, 1836. — A well-marked, but little known tree, of very limited geographical distribution, being confined, as far as known, to the Santa Lucia Mountains in Southern California, though other localities in different parts of California are attributed to it by seed dealers, and having been gathered only by very

[5] The color of the cones is often considered as of specific value, but in the Black Forest of Germany all the shades between light green and deep purple may be seen on the cones of *A. pectinata*, just as in our *concolor* in Colorado.

few collectors. — Leaves linear-lanceolate, always acute, of very firm texture. The bract is scarcely longer than the somewhat rounded, glabrous (all the other firs have pubescent ones) scale, but its awn or midrib protrudes 1–1½ inches; wing of seed rounded.

8. A. NOBILIS (*Pinus*, Dougl. Comp. Bot. Mag. 2, 147, 1836; Parl. l. c. 419), Lindl. Penn. Cyc. 1, No. 5. *Pseudotsuga nobilis*, Bertrand, McNab, under *Pinus:* the red fir of the Cascades in Oregon, extending southward to the Shasta region of California; stately trees, 200 feet high, with rigid, glaucous foliage; thick, rough, cinnamon-brown bark, and useful timber. A section in the Oregon collection of the Centennial Exhibition was taken from a tree 2½ feet in diameter, bark 1 inch thick, 119 annual rings of nearly even thickness throughout. The leaves of young trees and of the lower sterile branches of old trees are longer, flat and grooved, the resin-ducts lateral, and the fibro-vascular bundles more or less divided in two; those of the fully developed and especially the fertile branches are shorter, flat-quadrangular, their thickness not more than ½ or rarely ⅔ of the width; [6] bundles single, cylindrical. Bracts more or less protruding and reflexed; scale high in proportion to its width (7 : 10); the oblique, angular wing of the seed about as wide as long, and as long as the slender seed; the only good seed I could examine had 7 cotyledons.

9. A. MAGNIFICA, Murray Proc. Hort. Soc. 3, 318, 1863. *A. nobilis* var. *robusta* in Hort. Dickson & Turnbull. *A. campylocarpa*, Murr. Trans. Bot. Soc. 6, 370. *A. amabilis* of the Californian botanists. *Pseudotsuga magnifica*, McNab: the red fir of the higher California sierras, at an altitude of 7–10,000 feet; large trees often 10 feet in diameter, over 200 feet high, with thick cinnamon-brown bark, and valuable wood.[7] Leaves of young specimens flat but scarcely grooved, never, I believe, notched, the fibrous bundles often in twos. On full-grown trees, and especially on fertile branches, the leaves are mostly ¼ wider than thick, or even perfectly square; the resin-ducts in these leaves are placed equidistant from the edges and the keel, separated from the epidermis by a layer of hypoderm cells, [602 (10)] which is externally indicated by a green stripe dividing the bands of stomata, so that these leaves show 4 lower white bands. Cones 6–8 inches long, 2½–3¼ thick, purple; bracts lanceolate, shorter than the broad scale (height to width as 6 : 10); wing of slender seed very oblique, wider than long; the only seed examined had 10 cotyledons.

Many years ago it was suggested by Mr. McNab of the Edinburgh garden, that *nobilis* and *magnifica* might be forms of the same species; some seedsmen of California seem, also, to have come to this conclusion; and now Messrs. Hooker and Gray, who a few months ago enjoyed the opportunity of examining both on their native mountains, incline to the same opinion; *magnifica* would thus be the southern, short-bracted, and *nobilis* the northern, long-bracted form. It is quite probable that the length of the bracts may vary; we know it of *nobilis*, but it is doubtful whether this could be the case to such an extent as to permit us to unite both species. In *magnifica* no lengthening of the bracts has been observed thus far, and in *nobilis* they never, I believe, become shorter than the scale. But besides this, I confess, rather doubtful difference in the length of an organ of minor importance, the flatter and grooved leaves of the young *nobilis*, and the higher and proportionately narrower scales of this species, together with the smaller number of cotyledons (if constant), seem to indicate specific distinction. Further explorations must show whether *magnifica*, or anything like it, grows in the regions which we know as the home of *nobilis*.

VI. CONIFERÆ OF WHEELER'S EXPEDITION.

FROM REPORT, GEOLOGICAL SURVEYS, ETC., VOL. VI., BOTANY, BY J. T. ROTHROCK, 1878, pp. 255–264.

ABIES [1] SUBALPINA, *Engelm. Am. Nat.* 1876, *p.* 554; *Trans. Ac. St. Louis*, 3, 597. *Abies grandis* in part, [255] of the Rocky Mountain botanists. — A large tree, 60–80 feet high, with very pale and thin, smooth, or only in very old trees, cracked, and ashy-gray bark; leaves ¾–1 inch long, dark green above, paler or whitish underneath, on the lower branches flat, grooved above, notched at tip and distichous, those of fertile or of erect shoots all around the axis, sharp-

[6] The leaf sections, figured by McNab, all seem to refer to young trees; none are as thick as I find them in native specimens.

[7] A section in the Agricultural Dep. of Cent. Exh., sent by J. G. Lemmon, indicates a tree 6½ feet in diameter, with brown, almost fibrous, bark, 3 inches thick, about 400 years old, with a pretty uniform growth, 10 rings measuring 1–2 inches in thickness, about the same as in a specimen of *nobilis* in the Oregon collection.

[1] ABIES, *Link*, not *Don; Abies* sect. (Firs), Gray's Man.; *Pinus* sect. *Abies*, Endl. Parlat.; *Picea*, Don. — Coniferous trees with more or less flattened, and on the sterile branchlets by a twist near their bases, two-ranked, sessile, persistent leaves, which eventually leave on the branches circular, flat scars; flowering from the axils of the leaves of the previous year; staminate flowers (usually called staminate aments) in the form of an oval or cylindrical ament; anthers without crests, bursting transversely with large (0.11–0.14^{mm} in the larger diameter) 2-lobed pollen-grains; cones erect on the more or less horizontal branchlets, maturing in one season; their scales with their enclosed or exsert membranaceous bracts falling from the persistent axis; seeds covered with balsam-receptacles, and partially but permanently enclosed in the pergamentaceous base of the wing, which covers the

pointed and convex and often with stomata above; cones cylindrical-oblong, retuse, 2½–3 inches or 3½ inches long, 1–1⅓ inches thick, of purplish-brown color; bracts broadly oval, denticulate, mucronate, much shorter than the nearly orbicular or sometimes somewhat quadrangular scale; purplish wings of seeds nearly twice longer than wide; cotyledons 4–5.

Colorado to Utah on the higher mountains and near to the timber-line; extending north and northwestwardly. A poor, soft, almost spongy timber, with paler bark than any other American species. The resin-ducts of the leaves are imbedded in the parenchyma, about equidistant from the upper and the lower surface.

ABIES CONCOLOR, *Lindley; Engelm. Trans. l. c.* 600. — A large tree, 80–150 feet high, with ash-colored, at last thick and much cracked bark, with longer and broader leaves than the last (in young trees often 2–3 inches long, shorter in old ones), 2-ranked, and when young glaucous, later pale dull green, with stomata on both sides; leaves on the upper branches obtuse, convex above, often falcate; cones cylindrical-oblong, obtuse, 3–4 inches or even 5 inches long, 1½–1¾ inches thick, mostly apple-green, sometimes purplish-gray; bracts orbicular-ovate, mostly mucronate, much shorter than the very broad, transversely dilated scale; wings of seeds pale, very oblique, as long as wide; [256] cotyledons 5–7, usually 6.

Common on the mountains of New Mexico and Arizona. Thence extending through Southern Colorado and Utah and throughout the California sierras. A tree of beautiful foliage, highly prized in cultivation; furnishing better timber than the last, from which (besides the characters already enumerated) it can always readily be distinguished by the two resin-ducts of its leaves lying close to the epidermis of the under surface. In Colorado as well as in California it has often been named *A. grandis*, a species which properly belongs to the coast regions of Oregon the Lower Columbia River, Vancouver Island, etc.

PICEA[2] ENGELMANNI, *Engelm.* *Abies Engelmanni*, Parry. *Pinus commutata*, Parlat. — Large trees, 60–100 feet high, with thin, cinnamon-brown, scaly bark; branchlets mostly pubescent; leaves 4-sided, slender and acute or acuminate in younger, and shorter, stouter, short-pointed, and curved in older trees (especially in higher altitudes), with stomata on both sides; cones oval or oblong, about 2 lines long, paler or purplish, falling off at maturity; scales thin, erose-denticulate, broad, with a rounded edge or usually somewhat prolonged upward and truncate; seeds half as long as the very oblique wing, usually with 6 cotyledons.

San Francisco Mountains, Bischoff; Sierra Blanca, Gilbert; Mount Graham, Rothrock (784). The most southern localities known of this northern and sub-alpine species, which extends through the Rocky Mountains to British Columbia and to Oregon, forming extensive forests. A beautiful tree, often 2 feet and even 3 feet in diameter; timber similar to that of *P. nigra* of the Northeast and *P. excelsa* of Europe: above timber-line, it dwarfs down to mere shrubs often prostrate, but loaded with cones.

PSEUDOTSUGA[3] DOUGLASII, *Carrière.* *Abies Douglasii*, Lindl. — Often one of the tallest trees known (in [257] favorable localities, in Oregon, even 300–350 feet high), with very thick, much cracked, brown bark, spreading branches, conspicuous, somewhat persistent bud-scales, slender, flat, linear, obtuse or acutish leaves, ¾–1¼, rarely 1½ inches long; cones ovate-oblong, usually 2–3 inches long, brown, well marked by the protruding, long-cuspidate bracts; scales orbicular, concave; oval wings about as long as the somewhat triangular, pale seeds; cotyledons 6–8.

Common through Arizona, as it is through all the western mountain regions, down into Mexico. — Leaves stomatose and whitish only on the lower surface, with 2 resin-ducts close to the epidermis of the under side.

PINUS[4] FLEXILIS, *James; Parlat. in DC. Prod.* 16, 2, 403. — A middle-sized tree, with a smoothish, or, in old trees, lightly furrowed, pale or ash-gray bark; leaves in fives, mostly entire and smooth-edged, 1¼–2 inches long, in a loose, outer and laps over the inner surface. — Stately trees of rapid growth, but with brittle and rapidly decaying wood.

[2] PICEA, *Link*, not *Don*; *Abies*, Don; *Abies*, sect. (Spruces), Gray's Man.; *Pinus sect. Picea*, Endl., Parlat. — Coniferous trees with single evergreen, more or less 4-sided leaves, which at last separate from a prominent, persistent, ligneous base; flowering from the axils of the leaves of the previous year; staminate flowers as in *Abies*, but stamens tipped with a large, nearly orbicular, denticulate crest; cells opening longitudinally; pollen as in *Abies*, 0.09–0.13^{mm} in longer diameter; cones pendulous from the ends of short or elongated branchlets, maturing in one season; scales and small enclosed membranaceous bracts persistent on the axis; seeds without balsam-vesicles, imbedded in the excavation of the membranaceous base of the wing, which leaves their under side nearly free and permits them to drop out. — Trees of slower growth than the firs, with white, soft, but tough, close, and highly esteemed timber.

[3] PSEUDOTSUGA, *Carr. Conif. ed.* 2, 256, *Abies* sect. *Tsuga* (in part), Endl. — Coniferous trees, with flattened, entire, somewhat 2-ranked, distinctly petioled leaves, leaving on the branchlets scarcely prominent, transversely oval scars; flowering from the axils of the leaves of the previous year; staminate flowers resembling an oval or subcylindrical ament; anthers with a recurved, spurlike point; cells opening longitudinally; pollen oval-subglobose; sessile cones subpendulous, maturing in one season; scales and their much elongated bracts persistent on their axis; seeds without balsam-vesicles, not separating from the wing. — Very large trees, with very thick bark and reddish or yellowish wood, of secondary value, which is characterized and well distinguished from the wood of all the allied genera, and of most coniferous woods, by the abundance of spiral vessels, otherwise so rare in this family. The difference in the pollen, the seeds, and the leaf structure make a separation of this genus from *Abies* as well as from *Tsuga* necessary.

[4] To the character of the genus *Pinus* may be added: Staminate flowers surrounded by an involucrum, of a some-

deciduous sheath, about ½ inch in length; involucre of the oval staminate flowers composed of 8–9 oval, obtuse scales; anthers with a short lacerate or toothed crest; cones sub-terminal,[5] spreading, or slightly reflexed ovate-cylindrical, 3–4½ inches long, squarrose by the more or less protruding thin-edged scales, the free part of which is [258] rounded or more or less triangular, rarely reflexed; seeds 5 or 6 lines long, somewhat angled, with a narrow deciduous wing-rim; cotyledons 6–7.

Var. *α*. SERRULATA. — Leaves slender, slightly and distantly serrulate, and as in the two following varieties, with few or scarcely any stomata on the back; cones of the ordinary form.

Var. *β*. MACROCARPA. — Leaves slender, entire; cones cylindric, 6–8 inches long, 2½ inches in diameter, the apophysis of the scales short, rounded.

Var. *γ*. REFLEXA. — Leaves as in last; cones ovate-cylindrical, about 4 inches long; apophysis elongated, reflexed.

A middle-sized tree, rarely more than 50 feet high, on the higher mountains of Colorado, New Mexico, and Arizona, extending to Southern California. Var. *α*. was found by Dr. Rothrock on Mount Graham (783); var. *γ*. by the same, on Santa Rita Mountain (east of Tucson), and in the Sanoita Valley (654 and 1001). The cone of 1001 resembles that of the Asiatic *P. Koraiensis*, or of a small *P. Ayacahuite* from Mexico. Var. *β*. was collected on the San Francisco Mountains by Mr. Ferdinand Bischoff in 1871. — The species is intermediate between the true *Strobi* and *Cembra;* of the former it has the peripheral resin-ducts, usually 2, on the dorsal side; with the latter it has the large, almost wingless seeds in common; from both it is distinguished by the back of the leaf being marked by a single, or a few series of stomata. It thus becomes the type of a third section of the *Strobus*-like Pines, which may be arranged as follows: —

1. *Cembræ*, with large, almost wingless seeds; dorsal face of leaves without stomata; resin-ducts of the serrulate leaves imbedded in the parenchyma; *P. Cembra* of Europe and Asia with appressed, and *P. Koraiensis* of Northeastern Asia with squarrose cone-scales. 2. *Flexiles*, with similar seeds, but entire or nearly entire leaves, with a few series of stomata on back, with peripheral ducts; *P. flexilis*, *P. albicaulis*, and the Asiatic *P. pygmæa*. This last is thus entirely distinct from *P. Cembra*, as a variety of which it has long been considered by Parlatore and other botanists, while *P. Mandschurica*, at least what I have seen under that name, is a true *Cembra*, not to be thrown together [259] with *P. pygmæa*, as has been done, and distinguished from *Cembra* itself by the denticulate *Strobus*-like leaf-tips. 3. *Eustrobi*, with distinctly winged seeds, leaves sharply serrulate on the edges, and generally denticulate all over the tip, mostly without stomata on the back, and with peripheral ducts, like the last. Of this subsection we have *P. Strobus*, *monticola*, and *Lambertiana;* Mexico has *P. Ayacahuite;* Japan, *P. parviflora;* the East Indies and Turkey, *P. excelsa* with *P. Peuce*.

PINUS MONOPHYLLOS, *Torr. & Frem. Report Expl. Exped.* 1842–1844, *p.* 319, *t.* 4; *Parlat. l. c.* 378. — A small tree, of scraggy growth, with gray bark and stout, mostly single,[6] terete leaves (rarely in pairs, and then semi-cylindrical and entire on the margins), 1½–2 inches long, ½–1 line thick or wide, with a deciduous sheath; involucre of the staminate flowers of about 6 scales; anthers with a short, entire, or denticulate knob; cones subterminal, ovate-sub-

what definite number of scales (3–15 or 20), the lowest, lateral, pair of which are strongly keeled; pollen-grains lobed, similar to that of *Abies* and *Picea*, but only half as large, 0.04–0.06 mm wide. The bracts of the cones, which, in the allied genera, remain membranaceous, become here much thickened and corky, and, together with the scale below them, form a sort of cell for the reception of the seeds. The base of the wing only partially covers the upper side of the seed, and usually forms a mere rim around the seed, which easily separates from it; in a few species, the wing is firmly attached to the seed, and in a few others it is reduced to a narrow margin; the seed never shows balsam-vesicles.

[5] The fertile aments of *Pinus*, and consequently the cones, are usually called *terminal*, but they never are that, but always *lateral*, and either appear between the uppermost leaves and the terminal bud, when they may be called sub-terminal (*P. resinosa*, *Strobus*, *sylvestris*), or the axis continues to elongate after the formation of the aments, when these and consequently the cones become *lateral*, the axis bearing leaves and sometimes other aments above them (*P. Tæda*, and especially *inops*, and in Europe, *P. Halepensis*). In some species both forms occur, or only a few leaf-bundles intervene between the aments and the terminal bud. When, in the following season, the axis elongates, while the ament matures to a cone, this latter naturally becomes quite lateral, but we continue to designate it as sub-terminal, in relation to its own, co-etaneous, part of the axis.

[6] The fresh leaves of pines, when single, are terete, and when dry, become grooved and ridged; the leaves which grow in pairs are semiterete, flat on the upper or inner, and convex on the lower or outer side, and only when (on the tree as well as still more in the herbarium) they become dry, they assume that channelled form which we find so often described as characteristic of a species; those leaves that grow in bundles of 3 or 5 are convex on the dorsal and ridged on the upper side; those with 3 are flattish, about half as thick as wide; those with 5 are triangular and nearly as thick as wide. It is therefore superfluous to minutely describe the form of the leaves, as that is already given when the number within the sheath is stated, nor is it proper to describe the dried and shrivelled condition. The serratures, their closeness, the size of the minute teeth or their absence (only in a few Western American species the edges of the leaves are without teeth) are of much greater importance, and to some extent the nature of the tip is also of value.

globose, 2 or 2½ inches long and nearly as thick, consisting of few large scales with thick pyramidal apophyses, but without prickles ; oval seeds about ½ inch long, with a wing nearly 1 line wide ; cotyledons 7–10.

The oft-described Nut-pine of Fremont's first expeditions, 35 years ago, common from Arizona to Utah and California. This and the following species furnish an important article of food to the Indians and other natives. That single leaf, before its nature was properly understood, troubled botanists a good deal, so that Endlicher, supposing that the single leaf consisted of two agglutinated ones, went so far as to change the name into *P. Fremontii*. They are really single leaves, and the only instance of such leaves in the genus (I do not speak of the primary leaves of seedlings or young shoots, but only of the secondary leaves, which grow in bundles on what we must take for reduced branchlets).

PINUS EDULIS, *Engelm. in Wisliz. Mem. note* 2. — Similar to the last, but with more slender, entire leaves, [260] mostly in pairs, rarely in threes ; staminate flowers surrounded by a 4-leaved involucre ; anthers with a knob or short spur ; cones and seeds similar to those of the last species, only a little smaller ; cones usually but 1½ inches long ; cotyledons as in previous species.

Camp Bowie, Arizona, Rothrock (493). Common from Southern Colorado through New Mexico to Arizona. The two species here described, together with the slender and 3-leaved *P. cembroides*, with harder shells to the larger seeds, and 8–12 cotyledons, and the little-known 4–5 leaved *P. Parryana* of the northern part of Lower California, constitute a small group of very peculiar Pines, which we may designate as the Cembroid Pines, characterized by the leaves of the *flexilis* group (with entire margins, peripheral ducts, and deciduous sheaths), by the seeds of *Cembra*, and by the cones and scales of *Pinaster*. Perhaps it would be proper not to lay too much stress on the number of leaves and minor characters, nor on their geographical difference, and to unite them under the oldest and most appropriate name of *P. cembroides*, Zucc., though systematists, counting the leaves, have separated them widely in their books.

There is no pine entirely analogous to them in the Old World, unless we should refer here the little-known *P. Bungeana*, Zucc. ; Murr. Conif. Jap. 18, of Northern China. It has similar, small, subglobose cones, though with less prominent knobs, but armed with recurved prickles ; the seeds are smaller, with a very distinct wing, the leaves in threes lose their sheaths as our Nut-pines do, but are serrulate, and have several peripheral ducts, but, singularly enough, also usually a single interior or parenchymatous one, forming thus a link between several groups.

PINUS ARIZONICA, *n. sp.* — A middle-sized tree, 40 feet high, 2–3 feet in diameter ; branches squarrose, with persistent bracts ; leaves in fives, 5–7 inches long, ½ line wide, closely serrulate, in a sheath over 1 inch long (when old less than half as long) ; oval cone 2¾ inches long, 1½ inches thick ; scales with a prominent knob, which in the lower ones is recurved, armed with a recurved prickle.

On the Santa Rita Mountains, in Southern Arizona, Rothrock (652), in 1874. "The best lumber of that region, there called yellow pine." This seems to be a meagre account to found a new species upon in a genus so [261] difficult as *Pinus*, but I find it impossible to unite it with any other of the allied species. It has the cone of *P. ponderosa*, especially of that form figured by Torrey as *P. deflexa*, and, like all forms of that species, it has the peculiarity that the fallen cones, found on the ground, are always imperfect, their lowest part remaining attached to the branch for another season ; I do not know of any other pine with this singular character. But we could not well class this 5-leaved pine with the 3-leaved *ponderosa*. On the other hand, the form of the cone and its scales will not permit us to refer it to the Mexican *P. Montezumæ*, though the structure of the leaf is very similar to that of this polymorphous species, which appears to include even *P. Hartwegii*. The three parenchymatous ducts of the leaf and the strengthening cells,[7] within the sheath of the vessels, are exactly as we find them in *Montezumæ*, and different from *ponderosa*.

PINUS PONDEROSA, *Dougl. Parlat. l. c.* 305. — A large tree, with large and spreading head, thick, deeply cracked, red-brown bark, and heavy, resinous yellowish wood ; thick branchlets, rough from leaf-scars and the persistent remnants of bracts ; leaves in twos or mostly in threes, 4–8 inches, in some rare forms 10–12 inches long, ¾ line wide, with sheaths at first 1 inch long, when old withering to 2 or 3 lines long ; staminate flowers cylindric, with an involucre of 10 or 12 scales, the lowest pair of which is about two-thirds as long as the innermost ; anthers with a large suborbicular crest ; fertile aments sub-terminal ; patulous cones oval or rarely elongated, very variable in size, 2–6 inches long ; knob of the scales more or less prominent, and in some forms even recurved, bearing a rather stout prickle ; seeds black, ridged on the lower side, wing broadest in the middle ; cotyledons 6–8, or in the largest seeds as many as 10.

Colorado, New Mexico, and Arizona, extending through the Northern Rocky Mountains and adjacent regions to Oregon and California, mostly in the middle altitudes ; the most common and most useful timber of many

[7] This name has been given to longitudinal cells with very thick walls, destitute of chlorophyll, which are characteristic of most pine-leaves, and by their different disposition aid in distinguishing them from one another. They are generally arranged close to the epidermis, and especially in the angles of the leaves, and have usually about the same diameter as the epidermis-cells themselves. We find them also occasionally surrounding the ducts, *e.g.* in *P. ponderosa*, also in the Cembroid Pines and in *P. Balfouriana* and *P. aristata* ; while in *P. flexilis* they always leave the ducts free, a character by which we can readily distinguish the leaves of these species, otherwise so similar. Not rarely are they found within the sheath, strengthening, as it seems, the centre of the leaf.

parts of that district and generally known there as "yellow pine." A most variable tree, several forms of which [262] have received distinct specific appellations, but the specimens collected in these expeditions all appear to belong to the ordinary smaller-leaved and smaller-fruited form. Whenever the macroscopic characters leave any doubt, the microscopic structure of the leaf appears to offer a sure guide. The leaves contain two or three or often more parenchymatous resin-ducts, usually of uncommonly small diameter, always with some, and often surrounded by many, of those strengthening cells of which I have spoken before; the same cells occur within the sheath, above and below the bundles of vessels. I have examined the leaves of 20–30 specimens from the whole range of the species, and have never failed to discover this same structure, which I must therefore consider as characteristic of the species.

PINUS CHIHUAHUANA, *Engelm. in Wislizen. Mem. note* 26; *Parlat. l. c.* 397. — A middle-sized tree, with ternate, closely serrulate leaves 2½–4 inches long; the loose glistening sheaths ½ inch long, deciduous after the first season; staminate flowers slender, cylindric, about ½ inch long, sometimes interspersed among the foliage; involucre as long as the nearly entire-margined bract, of 8–10 scales, the outer about half as long as the inner ones; anthers with an almost orbicular crest; oval cones sub-terminal, small, 1½ inches long; knobs of the scales bearing recurved, deciduous prickles.

Southern Arizona, in Sanoita Valley, at 6,500 feet altitude, Rothrock (649), in 1874; also Wright, and in Western Chihuahua, Wislizenus. — A tree 30–50 feet high, "with bark resembling yellow pine;" easily distinguished by the characters given, and especially by its deciduous sheaths. All the Strobi and Cembroids have such deciduous sheaths, but among the Pinasters the sheaths are persistent, except in one or two Mexican species, in *P. Bungeana*, above mentioned, and in this species. Leaves strongly and closely serrulate, and with three or often four parenchymatous ducts.

PINUS CONTORTA, *Dougl.*, *var.* LATIFOLIA, *Engelm.* *P. Murrayana*, Balf. Oreg. Com. Rep. — A middle-sized tree, sometimes 60–80 feet high, and 2–4 feet in diameter, with thin, scaly bark of grayish to red-brown color, and close, white, rather soft wood; leaves in pairs, 1½–2 inches or rarely 3 inches long and 1 line wide; staminate flowers oblong, 6 lines in length, their involucre commonly of 6 scales; crest of the anthers rounded; pistillate [263] aments subterminal, their scales with erect or spreading points; cones oval, usually very oblique, and often curved, reflexed, 1½–2 inches long; scales, especially the lower ones, with largely developed pyramidal knobs in the centre, much smaller on the inner side, armed with strong or sometimes slender, awnlike prickles; seeds black, rough, ridged on the lower side; wing widest below the middle; cotyledons usually 5.

Southern Colorado to California, apparently not noticed in Arizona. A valuable timber tree of the northern mountain regions, forming large forests in the higher altitudes of the Rocky and California mountains, reaching into the British Possessions. The original form, discovered by Douglas near the mouth of the Columbia River (*P. Bolanderi*, Parlat.), is a seaside tree, extending up and down the coast, resisting the ocean storms, as does *P. Halepensis* those of the Mediterranean, and protecting the inside vegetation; it is distinguished by its low, scrubby, and often shrubby growth (whence probably the name), and its slender leaves, not more than ½–⅔ lines wide; northward, in British Columbia and Alaska, both forms completely run together. The species was formerly confounded with the eastern *P. inops*, which differs by its lateral, more or less pedunculated cones; it is more closely allied with the Northern *P. Banksiana*, which, however, bears its scarcely prickly or entirely unarmed, mostly lateral, rarely sub-terminal, cones erect or patulous, never recurved: a very unusual occurrence among pines. The cones of the Rocky Mountain form, and also those of the seaside scrub, are usually persistent for many years, and often remain closed after maturity (serotinous), while in the variety of the Sierras, they appear to open on maturity, and to drop before the following season, as Prof. C. S. Sargent observed.

JUNIPERUS VIRGINIANA, *Linn.*; *Engelm. American Junip. in Trans. Ac. St. Louis*, 3, 591. — Santa Fé, N. Mex. Rothrock, in 1874 (43). Readily distinguished by its slender branchlets and leaves with entire margins.

JUNIPERUS OCCIDENTALIS, *Hook.*, var. MONOSPERMA, *Engelm. Junip.* 590. — A small tree or a bush, with fibrous bark, squarrose branches; and obtuse, minutely denticulate leaves in twos and threes; berries globose, blue-black, or sometimes copper-colored, 3–5 lines thick, resinous, pulpy; seeds 1 or 2.

Chiricahua Agency, Arizona, Rothrock. A form common from Southern Colorado to New Mexico and [264] westward; distinguished from the original *J. occidentalis* of Oregon and California by its more squarrose growth, thinner branches, and smaller fruit.

JUNIPERUS PACHYPHLŒA, *Torr. Bot. Whipp. in Pacific. R. R. Rep.* 4, 142; *Engelm. l. c.* 589. — A middle-sized tree, with spreading head and thick, fissured bark; branchlets slender; leaves elongated, often resiniferous on the back, with slightly denticulate margins; berries large, glaucous, many-seeded.

An important tree in Western New Mexico (Fort Wingate, Rothrock, number 140, in 1874) and Northern Arizona; readily distinguished from all the other species by its bark, which Dr. Rothrock compares with that of the white oak, and others with the bark of pine.

JUNIPERUS CALIFORNICA, *Carr.*, var. UTAHENSIS, *Engelm. Junip.* 588. — More slender than the western type, *J. Californica*, with thinner branches and smaller, not so strongly fringed leaves, often in twos; smaller, more globose berries; embryo with 5 cotyledons, as in the species.

Camp Apache, Arizona, Gilbert, Rothrock.

VII. THE AMERICAN SPRUCES.

From the Gardeners' Chronicle, n. s., Vol. XI. Mar. 15, 1879.

PICEA, Link not Don. [334]

A. Leaves more or less square ; stomata on all sides.

a. Northeastern and Northern species.

1. Picea alba, with slenderer leaves on the glabrous branchlets ; cylinder cones with smooth-edged flexible scales, deciduous after maturity.

2. Picea nigra, with stouter leaves on the pubescent branchlets ; ovate cones with rigid denticulate scales, more or less persistent.

Var. rubra, with larger, darker leaves ; larger bright red brown cones, more readily deciduous after maturity.

b. Rocky Mountain species.

3. Picea Engelmanni (*Pinus commutata*, Parlat.), with stouter leaves on the pubescent branchlets ; sub-cylindric cones with flexible, erose, or emarginate scales ; deciduous.

4. Picea pungens (*Abies Menziesii* of the Rocky Mountain flora), with glabrous branchlets ; very rigid, strongly pointed and pungent leaves, in young trees compressed, in old ones often flattened ; large cylindrical cones, with very pale, elongated, emarginate, very flexible, squarrose scales ; seeds larger, with a broad obovate wing, and 5–8 cotyledons.[1]

B. Leaves flattened ; stomata only on the upper side. Pacific Coast species.

5. Picea Sitchensis (*Abies Menziesii* of the Pacific coasts). — Leaves thin, blunt or short-pointed ; cones much shorter than in last ; scales similar ; seeds small, with a very narrow wing, and only four cotyledons. Seems to include several East Asiatic nominal species.[2]

VIII. ABIETINEÆ OF CALIFORNIA.

From Botany of California, 1880, Vol. II. [Advance pages issued in October 1879.]

7. ABIES, Link. Fir.*

Flowers from the axils of last year's leaves : male flowers in the form of an oval or cylindrical stamineal [117] column, its short stipe surrounded by numerous bud scales ; commissure of the anthers terminating in a knob ; cells bursting transversely ; pollen-grains large (.06 to .07 line long), with 2 air-sacs. Female aments erect, the bract much larger than the scale. Cones maturing in the first year, erect, their scales and enclosed or exsert membranaceous bracts falling at maturity from the persistent axis. Seeds covered with resin-vesicles and partially but permanently enclosed in the pergamentaceous base of the wing, which covers the outer and laps over upon the inner surface. Cotyledons normally 4 to 10. — Magnificent trees, of pyramidal form and rapid growth, but with brittle and easily decaying wood ; leaves sessile, with a circular never prominent base, mostly more or less flattened and often emarginate, on the horizontal branchlets appearing 2-ranked by a twist near the base, bearing stomata only or mainly on the lower surface, with two longitudinal resin-ducts mostly close to the epidermis of the lower side or, in some species, within the parenchyma. — Engelm. in Trans. St. Louis Acad. iii. 593. *Abies*, Tournefort, in part. *Pinus*, Linn., in part. *Pinus*, sect. *Abies*, Endlicher ; Parlatore. *Picea*, Don.

[1] A very blue form of this has lately been cultivated in English nurseries under the name of *Abies Parryana*.

[2] *Abies Sitchensis* is the oldest specific name, and must be substituted for the more generally adopted *Menziesii*. *A. Jezoensis* (in part), *A. microsperma*, and perhaps others, seem to belong here ; and the lately discovered Servian *A. Omorika* apparently stands very near it.

* The synopsis of this genus, with wood-cuts, is reprinted in the *Gardeners' Chronicle*, n. s., Vol. xii., Nov. 29, 1879, pp. 684–685. — Eds.

The 16 or 18 species of this genus are confined to the mountainous regions of the northern hemisphere, one half to the Old, the other half to the New World. Of these two are found northward and eastward, one in Mexico, and the rest in the mountains of the Pacific slope.

* Leaves flat or flattish. [118]

+ Upper side of the leaves dark green, glossy, and without stomata.

++ Leaves acute : linear tip of the bracts long-exserted.

1. A. BRACTEATA, *Nutt.* A tall slender strictly pyramidal tree, 100 to 150 feet high and 1 or 2 feet in diameter, with brown bark : leaves mostly somewhat 2-ranked, linear or linear-lanceolate, an inch or two long by 1 to 1½ lines wide, with two pale (or in young leaves white) bands beneath : cones oval to subcylindric, 3 or 4 inches long and 1½ to 2 inches thick ; bracts cuneate-obcordate, scarcely exceeding the transversely oval glabrous scales, terminating in elongated linear foliaceous midribs or awns (1 to 1½ inches long) : seeds as long as the obovate rounded wing. — Sylva, iii. 137, t. 118 ; Hook. Bot. Mag. t. 4740 ; Murr. in Edinb. New Phil. Journ. x. 1, t. 2 ; Engelm. l. c. 601. *Pinus venusta*, Dougl. in Comp. Bot. Mag. ii. 152. *P. bracteata*, Don, Trans. Linn. Soc. xvii. 442.

Thus far only known from the Santa Lucia Mountains, at an elevation of 3,000 to 6,000 feet. The pointed buds are unusually large for the genus (about half an inch long), covered with imbricated scales.

++ ++ Leaves obtuse or emarginate : bracts enclosed.

2. A. GRANDIS, *Lindl.* Very tall (200 to 300 feet high and 3 or 4 feet in diameter), with smooth brownish bark : leaves channelled above and glossy, with two pale or white bands beneath, an inch or two long and somewhat 2-ranked on the younger or lower branches, on the higher branchlets shorter, somewhat cuneate, and crowded on their upper side : cones cylindric, retuse, 2 to 4 inches long, with scales (13 or 14 lines wide) nearly twice broader than high, the quite short obcordate or 2-lobed bracts with or without a short point : wing of the seeds very oblique, about as broad as long. — Penny Cyc. i. 30 ; Engelm. l. c. 598. *Pinus grandis*, Dougl. ; Parlat. *P. amabilis*, Dougl. ?; not of later authors. *Picea grandis*, Loud. Arbor. iv. 2341, fig. ; Newberry, Pacif. R. Rep. vi. 46, fig. 16 and t. 6.

Confined principally to the northern Pacific Coast, where it extends from British Columbia to Northern California, as far south as Mendocino. Probably the largest fir known ; in Oregon one of the important timber-trees, though the wood is inferior to that of the Douglas and Sitcha spruces. Readily distinguished from the mountain firs by the glossy green upper surface of the leaves, and by the other characters enumerated above.

+ + Leaves pale and with stomata on both sides.

3. A. CONCOLOR, *Lindl.* A large tree, 80 to 150 feet high with a diameter of 2 to 4 feet, with rough grayish bark : leaves mostly obtuse, pale green, those of younger trees and lower branches elongated, 2 to 2½ and even 3 inches long, 2-ranked, often slightly channelled and notched, those of old trees and of upper cone-bearing branches shorter (an inch long), broader, thicker, convex above and often falcate, covering the upper side of the branchlets : cones oblong-cylindrical, 3, 4, or even 5 inches long and 1¼ to 1¾ inches in diameter, pale green or sometimes dull purplish ; scales (12 to 15 lines wide) nearly twice wider than high ; bracts short, enclosed, truncate or emarginate, with or without a short mucro : wing of the seeds oblique, as long as broad : cotyledons 5 to 7. — Journ. Hort. Soc. v. 210 ; Engelm. l. c. 600, and Wheeler's Rep. vi. 255. *Picea concolor*, Gordon, Pin. 155. *Pinus concolor*, Engelm. ; Parlat. in DC. Prodr. xvi^2, 426. *Abies Lowiana*, Murr. *A. grandis* of the Californian botanists. *A. amabilis* (?), Watson, Bot. King Exp. 333.

A common fir throughout the Californian sierras, from 3,000 or 4,000 to 8,000 feet elevation, extending into Southern Oregon and through the mountains of Arizona to Utah and S. Colorado. Always readily recognized by the gray bark of the trunk (whence often called in California "White Fir"), and by the pale color of the foliage, which at last becomes dull green. A very ornamental tree, especially the paler variety, but the timber is not much esteemed. *P. Lowiana*, known also in nurseries as *P. Parsoniana*, *lasiocarpa*, and *amabilis*, distinguished by its longer flatter straighter leaves with fewer stomata on the upper side, is a young and vigorous state of this species, which has not yet fruited in cultivation.

* * Leaves more or less quadrangular, short and curved upward. [119]

+ Bracts exsert.

4. A. NOBILIS, *Lindl.* — A magnificent tree, 200 feet high, with thick cinnamon-brown bark (red inside) : leaves rigid, curved upward, covering the upper side of the branchlets, glaucous and stomatose and keeled both on the upper and under side, acute or obtuse, about an inch long, only on the youngest trees or lowest branches longer (1½ inches), flatter, slightly grooved and somewhat 2-ranked ; cones cylindrical-oblong, thick, 6 to 9 inches long by 2½ or 3 inches broad, obtuse, almost covered by the exsert reflexed cuneate cuspidate bracts ; scales comparatively narrow (1½ inches wide, by an inch long or more) : seeds slender, with a cuneate-triangular somewhat retuse wing : embryo with 7 or 8 cotyledons. — Penny Cyc. i. 30; Nutt. l. c., t. 117; Engelm. l. c. 601. *Pinus nobilis*, Dougl. ; Parlat. *Picea nobilis*, Loud. l. c. 2342, fig.; Newberry, l. c. 49, fig. 17.

The "Red Fir" of Northern California, forming large forests about the base of Mount Shasta, at 6,000 to 8,000 feet altitude, and extending through the Cascade Mountains to the Columbia River. The timber is said to be better than that of other firs. Forms are found with almost enclosed bracts, often accompanying the others, which may connect with the following species.

+– +– Bracts enclosed.

5. A. MAGNIFICA, *Murray.* — Similar to the last, even more than 200 feet high and 8 to 10 feet in diameter, with the same kind of thick red-brown bark, and with similar very rigid foliage, but the leaves never grooved nor notched even on the young trees, on older branches shorter and thicker, so that they are mostly only a fourth wider than thick or even perfectly square, and often only 6 to 9 lines long: cones 6 to 8 inches long, $2\frac{1}{2}$ to $3\frac{1}{4}$ inches thick, purplish brown; bracts lanceolate, acuminate, shorter than the very wide scales, which are $1\frac{1}{2}$ to $1\frac{3}{4}$ inches broad by scarcely an inch high: seeds slender, the wing broader, very obliquely obovate-cuneate: cotyledons 8 to 10. — Proc. Hort. Soc. iii. 318; Engelm. l. c. 601. *Abies amabilis* of Californian botanists.

The "Red Fir" of the higher Sierras is not rare at an altitude of 7,000 to 10,000 feet, but forms no forests by itself. Easily distinguished from the last by the enclosed bracts. Forms, however, are said to occur (Mount Silliman, *Brewer*) with exsert bracts, and it remains to be seen whether the slight differences in the leaves, scales, and seeds will suffice to keep the species separate.

8. PSEUDOTSUGA, CARRIÈRE. DOUGLAS SPRUCE.

Flowers from the axils of last year's leaves. Male flowers an oblong or subcylindrical stamineal column, surrounded and partly enclosed by numerous conspicuous orbicular bud-scales; commissure of the anthers terminating in a short spur, the cells opening obliquely by one continuous slit; pollen-grains ovate-subglobose. Female flowers with the scales much shorter than the broadly linear acutely 2-lobed and long-pointed or aristate bracts. Cones maturing in the first year, with persistent scales and exsert bracts. Seeds without resin-vesicles, the wing at last breaking off. Cotyledons 6 to 12. — A very large tree, at first pyramidal and spruce-like, often at last more spreading, with yellow or reddish rather coarse but very valuable wood, which is distinguished from that of all the allied conifers by the abundance of spirally marked wood-cells. Leaves flat, distinctly petioled, somewhat 2-ranked by a twist at the base, stomatose only on the lower surface, with two lateral resin-ducts close to the epidermis of the under side, leaving on the branchlets scarcely prominent transversely oval scars. — Conif. 2 ed. 256. *Pinus*, sect. *Tsuga*, Endl., in part; Parlat. *Abies*, Lindl., in part.

A single species, which extends through the Rocky Mountains and mountains of California, from Oregon far into Mexico, and is in Oregon the largest and most important timber-tree.

1. P. DOUGLASII, *Carr. l. c.* A gigantic tree (200 to over 300 feet high and 8 to 15 feet in diameter), with [120] very thick brown deeply fissured bark: leaves linear, distinctly petioled, mostly obtuse or obtusish, 8 to 12 lines long, or on robust shoots even 16 lines long, by $\frac{2}{3}$ line wide: male flowers oblong-cylindrical, 5 to 10 lines long, half enclosed in large loose orbicular involucral scales: cones 2 to 3 or rarely 4 inches long, subcylindrical; bracts more or less exsert and spreading or reflexed: seeds triangular, on the upper side convex and reddish brown, on the lower flat and white, 3 lines long; wings 3 to $4\frac{1}{2}$ lines long, broadest at base, acutish: cotyledons 6 to 8. — Engelm. in Wheeler's Rep. vi. 257. *Pinus Douglasii*, Sabine; Hook. Fl. Bor.-Am. ii. 162, t. 183; Parlat. in DC. Prodr. xvi^2. 430. *Abies Douglasii*, Lindl.; Nutt. Sylva, iii. 129, t. 115; Newberry, Pacif. R. Rep. vi. 54, t. 8. *Tsuga Douglasii*, Carr.

Var. MACROCARPA. A smaller tree, 40 to 50 or rarely 80 feet high, $1\frac{1}{2}$ to 2 or 3 feet thick, with long spreading branches, and narrower, often acutish leaves: male flowers nearly an inch long: cones 5 to 7 inches long, 2 inches thick; scales large in proportion; bracts not as long as in the typical form: seeds and wing both 5 lines long: cotyledons 9 to 12. — *Abies Douglasii*, var. *macrocarpa*, Torr. in Ives's Rep. 28. *A. macrocarpa*, Vasey in Gard. Monthly, Jan. 1876.

Throughout the Coast Ranges and in the Sierra Nevada up to 6,000 or 8,000 feet, and also northward near the coast, attaining its largest proportions in Oregon, and extending in a smaller form to the Rocky Mountains. A beautiful tree, readily distinguished by its fringed cones, or else by the flat always petioled leaves. The variety occurs in the cañons of the foothills of the San Bernardino Mountains, and in the San Felipe Cañon, at an elevation of 3,000 to 5,000 feet, with oaks and below most of the coniferous trees. It looks very distinct, but with the exception of the proportions of the cones and seeds no reliable specific characters can be discovered. Transition forms between the two have not yet been found.

9. TSUGA, CARRIÈRE. HEMLOCK SPRUCE.*

Male flowers a subglobose cluster of stamens, from the axils of last year's leaves, the long stipe surrounded by numerous bud-scales; commissure of the anthers terminating in a short spur or knob; cells opening transversely by a

* For reprint see *Gardeners' Chronicle*, n. s., Vol. XII. Dec. 13, 1879, p. 756. — EDS.

continuous slit. Female aments terminal on last year's branchlets; bracts somewhat shorter than the scale. Cones maturing in the first year, pendulous; scales and short enclosed bracts persistent on the axis. Seeds with resin-vesicles on the surface; wing at last breaking off. Cotyledons 3 to 5 or 6. — Large trees, with slender often drooping terminal branchlets; leaves flat or angled, appearing 2-ranked, with a single dorsal resin-duct, conspicuously petioled, articulated on a prominent and at length ligneous and persistent base. — Conif. 185. *Pinus*, Linn., in part. *Pinus*, sect. *Tsuga*, Endl.; Parlat. *Abies*, Michx., in part.

Of the 5 species of this genus, two belong to eastern Asia, one to eastern and two to western North America. Four of these species are so closely allied that they can be distinguished only with difficulty. The single species of our second section has somewhat aberrant characters.

* Leaves flat, obtuse, stomatose only beneath: pollen-grains discoidal: cones small, an inch long or less. — EUTSUGA.

1. T. MERTENSIANA, *Carr.* A very large tree (100 to 200 feet high), with rather thick red-brown bark; ultimate branchlets very slender, roughish, and when young long-hairy: leaves linear, 4 to 9 lines long, and about ¾ line wide, abruptly petioled, entire or usually minutely spinulose-serrate toward the rounded tip, shining above, when young with two white bands beneath: male flowers 2 or 2½ lines in diameter, shorter than the stipe: cones oblong-cylindrical, pointed, slightly pubescent; bracts truncate; scales longer than wide: seeds 1 to 1½ lines long, the wing twice as long or more, scarcely widened toward the base: cotyledons 3, sometimes 4. — Conif. 2 ed. 250. *Pinus Mertensiana*, Bong. Veg. Sitch. 45; Parlat. *Abies Mertensiana*, Lindl. & Gord. *A. Albertiana*, Murr. *A. Bridgei*, Kell. Proc. Calif. Acad. ii. 8. [121]

Peculiar to the Pacific Coast region, from Marin County (*G. R. Vasey*) and especially Mendocino (*Bolander*, *Kellogg*) to Alaska. Closely allied to the northeastern *T. Canadensis*, but a larger tree, with finer and straighter grained wood and redder bark, principally distinguished by the more elongated scales of the cone and the proportionately much longer and straighter wings of the seeds; in the eastern species the scales are almost as wide as they are long and the seeds larger, but the wings, very broad at base and almost triangular, are only ¼ or ⅓ longer than the seed. Another character taken from the leaf-structure, the presence of hypoderm cells on the edges, midrib, and keel of the leaf, is not reliable, as these cells are occasionally found in leaves of *T. Canadensis*, though usually absent.

* * Leaves mostly convex or keeled above, acutish, stomatose both sides: pollen-grains bilobed: cones larger. — HESPEROPEUCE.

2. T. PATTONIANA. A tall strictly pyramidal tree (100 to 150 feet high and 2 to rarely 4 feet through, in high altitudes only a shrub), of graceful habit, with slender pubescent branchlets and light green foliage: bark thick, much cracked and apt to scale off, reddish gray: leaves 6 to 12 lines long, angular, acutish, attenuate at base, often curved: male flowers about 2 lines wide, on a very slender stipe: cones cylindrical-oblong, 2 or 3 inches long: seeds 2½ lines in length, the wing not twice as long (about 4 lines), obliquely obovate, widest above. — *Abies Pattonii* or *Pattoniana*, Jeffrey. *A. Hookeriana*, Murray. *A. Williamsonii*, Newberry, Pacif. R. Rep. vi. 53, t. 7. *Pinus Pattoniana*, Parlat.

In the highest timber regions of the Sierra Nevada, at 8,000 to 10,000 feet altitude, from Ebbett's Pass at the head of the San Joaquin River northward, and through the Cascade Mountains, near Crescent City descending to near the coast (*Brewer*). At the timber-line its proportions are much stinted. Though differing in the shape of the leaves, the disposition of the stomata, and especially in the form of the pollen-grains, which resemble those of the true pines, yet I cannot separate this species from *Tsuga*, with which the single resin-duct of the leaves, the form of the male flowers, and the glands of the seed unite it.

10. PICEA, LINK. SPRUCE.

Male flowers axillary or sometimes terminal on last year's branchlets, with an oblong or cylindrical stamineal column, its short stipe surrounded by numerous bud-scales; the commissure of the anthers expanding into a broad nearly circular erect crest; cells opening longitudinally: pollen-grains as in *Abies* (.045 to .065 line long). Female aments at the end of short or longer branchlets, the scales much larger than the bracts Cones maturing in the first year, pendulous: scales and enclosed bracts persistent on the axis. Seeds without resin-vesicles, imbedded in the membranaceous base of the wing, which leaves their under side nearly free and permits them to drop out. Cotyledons 4 to 8. — Stately trees of pyramidal form and slower growth, with white soft close tough highly valued timber; leaves keeled above and beneath, more or less quadrangular or (in our species) flattened, articulated on a prominent at last ligneous and persistent rhombic base, spirally arranged all around the branchlets or (by a twist of the base) somewhat 2-ranked, the stomata usually more on the upper than on the lower surface, or, on the flat leaves, often only on the upper side (which is then apt to be turned downward); resin-ducts irregular, 1 or 2 lateral ones close to the epidermis of the lower side or none. — *Abies*, Tourn., in part; DC., in part; *Pinus*, Linn., in part. *Pinus*, sect. *Picea*, Endl.; Parlat. *Abies*, Don.

An important genus of about a dozen species, peculiar to mountainous and northern regions, of which 2 belong to Europe, 5 to Asia, and 5 to America; of the latter 2 are northeastern, and 3 are western species.

1. P. SITCHENSIS, *Carr.* A tall strictly pyramidal tree (150 to 200 feet high and 6 to 9 feet in diameter), [122] with thin scaly red-brown bark ; branchlets thick and rigid, rough with the very prominent persistent leaf-bases, glabrous : leaves 5 to 8 lines long and a line wide or less, flattened, short-pointed (rarely obtuse or very acute), stomatose (and the young leaves white) only on the upper surface or very slightly so on the lower : cones cylindrical-oval, 1½ to 2½ or rarely 3 inches long, an inch thick or less, pale yellowish, the conspicuous lanceolate rigid bracts ⅓ or ½ the length of the oblong rounded denticulate scales : seeds slender 1¼ to 1½ lines long, the wing 2½ to 3 times longer (4 to 4½ lines long by 1½ wide), narrowly oblong, only slightly oblique : cotyledons 4 to 6. — Conif. 260. *Pinus Sitchensis*, Bong. Veg. Sitch. 46. *Abies*, Lindl. & Gord. *Pinus Menziesii*, Dougl. ; Lamb. Pin. 2 ed. t. 89. *Abies Menziesii*, Lindl. in Penny Cyc. i. 32 ; Loud. Arbor. iv. 2321, fig. ; Nutt. Sylva, t. 116 ; Newberry, Pacif. R. Rep. vi. 56, t. 9.

Peculiar to the northern Pacific coast, mostly in wet sandy soil and near the mouths of streams, from Mendocino and Crescent City northward to Alaska; how far inland or how high above the ocean it may be found is at present unknown. This is probably the tallest spruce known, an excellent timber-tree, probably the best in Oregon, but too rare in California to be of much importance there. The older specific name, *Sitchensis*, must be substituted for the more generally used *Menziesii*, which represents absolutely the same species. The Rocky Mountain Spruce, which has heretofore been known under the same name of *Menziesii*, is *P. pungens*, Engelm., with more pungent and less flattened leaves, longer cylindrical cones, undulate retuse scales, and minute bracts, and with larger broadly winged seeds. — In Strawberry Valley and other valleys and slopes about Mount Shasta, at an elevation of 3,500 to 4,000 feet, a peculiar spruce occurs of which at present we know nothing but that its lower branches are very long, slender, and pendulous, and the leaves much narrower than those of *P. Sitchensis*, 7 to 9 lines long and two thirds of a line wide, quite obtuse, strongly keeled and stomatose on the upper side and without stomata beneath ; cones unknown. The name of *Picea pendula* suggests itself for this form, if indeed it should not prove to be a mountain variety of *P. Sitchensis*.

11. PINUS, TOURN. ; LINK. PINE.

Staminate flower an oblong or cylindrical often much elongated stamineal column, surrounded by a somewhat definite number (3 to 18) of calyx-like bud-scales, the outer ones lateral and strongly keeled, from the axils of scales and crowded into a capitate or spicate inflorescence around the base of the same spring's shoots : anther-cells opening longitudinally, the connective terminating in a mere knob or short dentate or usually larger semicircular erect crest : pollen-grains bilobed with 2 air-sacs, smaller than in *Abies* and *Picea* (.02 to .03 line long). Female aments also in the axils of bud-scales, higher up on the growing axis, either next to the terminal bud (subterminal) or on the side with leaves and sometimes other aments above them (lateral), solitary or several together ; scales much larger than the bracts. Cones maturing in the second year, spreading or reflexed (very rarely erect), and subterminal (so called even in case of the elongation of the axis in the second year) or lateral ; bracts thickened and corky and assisting in the formation of cells for the seeds under them; scales more or less thickened and corky, upon the free exposed surface (*apophysis*) bearing a terminal or dorsal unarmed or prickly protuberance (*umbo*). Seeds without resin-vesicles, usually surrounded by the rim-like base of the (sometimes very short) wing, which often spreads partly over the outer side of the seed. Cotyledons normally 5 to 15. — Trees of very various size and aspect, usually not as large as in the preceding genera, nor often of the same pyramidal growth ; wood soft or hard, often very resinous, of surpassing importance for man's uses : primary leaves (only on seedlings and young shoots) flat, subulate and serrulate, the secondary in bundles of 1 to 5, from the axils of bud-scales and surrounded at base by a more or less persistent sheath of membranous [123] scales, needle-shaped, terete or semiterete or triangular according as the fascicles are of 1, 2, or more, mostly delicately serrulate, with stomata on all sides or rarely only on the upper inner sides ; resin-ducts peripheral (close to the epidermis) or parenchymatous (within the cellular tissue) or internal (close to the cellular sheath surrounding the pith and vascular bundles), varying in number in the same species ; strengthening cells (thick-walled longitudinal *hypoderm* cells) distributed under the epidermis, especially at the angles and keel, and often around the ducts, very rarely absent : seeds becoming detached from the wing at maturity, or rarely remaining adherent and at last breaking off. — *Pinus*, Linn., Endlicher, Parlatore, in part.

The largest and, geologically, the oldest coniferous genus, of 60 or 70 recent species, of which 24 belong to the Old World and nearly twice as many to the New. About 15 species are Mexican and West Indian, 11 belong to the Atlantic States, and 15 to the Rocky Mountains and the Pacific slope.

§ 1. Apophysis generally thinner, with a terminal unarmed umbo : anthers terminating in a knob or a few teeth or in a short incomplete crest : leaves in fives, with peripheral ducts (in our species), their sheaths loose and deciduous : cones subterminal. — STROBUS.

* Wings longer than the seeds : leaves serrulate and (at least when young) denticulate at the blunt tip : female aments long-peduncled, erect : cones pendulous in the second year.

1. P. MONTICOLA, *Dougl.* A tree 60 to 80 feet high and sometimes 3 feet in diameter, with smoothish pale bark splitting into square plates : leaves mostly 2 (occasionally 4) inches long, with 2 to 6 lines of stomata on the sides, rarely

any on the back ; teeth very small and distant : male flowers oval, surrounded by 8 involucral scales ; anthers knobbed or short-crested : cones cylindrical, slender, 5 to 8 inches long, yellowish brown : seeds pale, 3 to 3½ inches long ; wings twice as long, widest in the middle, pointed : cotyledons 6 to 9. — Lamb. Pin. 2 ed. iii. t. 67; Loud. Arbor. iv. 2291, fig. ; Parlat. in DC. Prodr. xvi². 405.

On the higher Sierra Nevada, from 7,000 or 8,000 to 10,000 feet altitude, from the Calaveras and Mount Raymond northward ; common in the Shasta region and on the Trinity Mountains, and extending to Oregon and Washington Territory. It is the western representative of the northeastern White Pine, from which it may be readily distinguished by the larger cones and stiffer and much less serrulate leaves, in which strengthening cells underlie almost the whole epidermis (but do not surround the ducts), while they are absent in the softer leaves of *P. Strobus*. The wood is said to be white and soft, as in the White Pine.

2. P. LAMBERTIANA, *Dougl.* A tree of gigantic dimensions, 150 to 300 feet high and 10 to 20 feet in diameter, with light-brown smoothish bark splitting in small sections : leaves 3½ to 4 inches long, rigid, with 5 or 6 lines of stomata on each of the 3 sides : male flowers oval, half an inch long, with 10 to 15 involucral scales ; anthers denticulate-crested : cones cylindrical, bright brown, 12 to 18 inches long and 3 or 4 inches wide, on peduncles 3 inches in length : seeds smooth, black, 6 lines long ; wing not quite twice as long, widest below the middle, obtuse : cotyledons 13 to 15. —Linn. Trans. xv. 500 ; Lamb. l. c., t. 68, 69 ; Loud. Arbor. iv. 2288, fig. ; Nutt. Sylva, iii. 122, t. 114 ; Newberry, Pacif. R. Rep. vi. 42, fig. 14 ; Parlat. l. c. 406.

Throughout the State and northward to the Columbia River, on both slopes of the Sierra Nevada, in a forest belt with *P. ponderosa* and *Abies concolor* at an elevation of 3,000 to 5,000 or sometimes 7,000 or 8,000 feet ; in the Coast Ranges only on the highest points, from the Santa Lucia Mountains to Humboldt County. Leaves stouter than in its allies, with a layer of strengthening cells under the whole epidermis and around the ducts. The wood is like that of the White Pine and similarly used. The exudation from the partially burned tree loses its resinous qualities and acquires a sweetness similar to that of sugar or manna, for which it is sometimes used, whence the name of "Sugar Pine."

* * Wings of the large seeds narrow : leaves entire or nearly so : cones subsessile, spreading, or declined. [124]

3. P. FLEXILIS, *James.* A tree about 60 feet high and 3 to 5 feet thick, with furrowed gray bark : leaves 1½ to 2 inches long, rarely more, with few rows of stomata on the sides and usually very few on the back : male flowers in a short spike, oval, 6 or 7 lines long, with 8 or 9 involucral scales ; anthers tipped by a spur or sometimes an incomplete crest : cones oval to subcylindric, 3 to 5 inches long, light brown, with somewhat squarrose scales : seeds oval, compressed, 4 to 6 lines long, the inconspicuous wing less than a line wide, usually remaining attached to the scale : cotyledons 6 to 9. — Long's Exp. ii. 27 and 35 ; Nutt. l. c., t. 112 (very poor) ; Engelm. Trans. Acad. St. Louis, ii. 208, and Wheeler's Rep. vi. 257 ; Parlat. l. c. 403.

Var. ALBICAULIS. A tree of 40 or 50 feet in height, on the highest elevations low and shrubby, with very pale bark : cones oval, or subglobose, 1½ to 3 inches long and 1½ to 2¼ thick, purple-brown ; scales much thicker and somewhat pointed. — *P. albicaulis*, Engelm. l. c. 209. *P. cembroides*, Newberry, l. c. 44, fig. 15. *P. Shasta*, Carr. Conif. 2 ed. 390.

The species has been found in California only on Mount Silliman (*Brewer*) with the variety, and on the Inyo Mountains (*Hoffman*), and thence eastward on the mountains of Nevada and Arizona to the Rocky Mountains, where it is common from New Mexico to Montana. The variety occurs on all the alpine peaks of the Sierra Nevada from Mono Pass to Mount Shasta and Scott Mountains, and northward to British Columbia, and also in Montana. More closely resembling *P. Cembra* of the Old World than our White Pines, but distinguished by the leaf-structure, which in *P. Cembra* shows parenchymatous ducts in the serrulate leaves. The peripheral ducts in our species are destitute of strengthening cells. *P. albicaulis* is probably only an alpine form, occupying a higher belt on the mountains, and marked by its short thick and thick-scaled cones. The large seeds are used for food by the Indians.

§ 2. Apophysis with a mucronate or (very rarely) blunt protuberance on the back : anthers terminating in a semi-orbicular or almost orbicular crest, except in the first three species. — PINASTER.

* Resin-ducts peripheral : leaves with entire margins and loose deciduous sheaths.

+ Leaves 1 to 5 : cones ovate-subglobose, with few very protuberant scales : seeds large, almost wingless.

4. P. MONOPHYLLA, *Torr. & Frem.* A small tree, 20 or 25 feet high, with irregularly spreading branches and pale fissured or flaky bark : leaves rigid, spiny-tipped, solitary and terete or rarely in pairs and semiterete, 1¼ to 2¼ (mostly 1½) inches long, the sheaths 4 or 5 lines long : male flowers oval, with 6 involucral bracts ; anthers terminating in a knob or a few teeth : cones 1½ to 2½ inches long and nearly as thick : seeds oval, 6 to 10 lines long, thick-shelled, yellowish brown and mottled : cotyledons 7 to 10. — Fremont's Rep. 319, t. 4 ; Parlat. l. c. 378 ; Engelm. Wheeler's Rep. vi. 259. *P. Fremontiana*, Endl. Conif. 183, in part.

In the Coast Ranges only about Fort Tejon, and from the eastern slope of the Sierra Nevada through Nevada and Arizona to S. Utah, frequent in the mountains and often in the most arid localities; well known as the "Nut Pine," and the seeds invaluable to the Indians as an article of food. It was long considered probable that the terete leaf was in reality a connate pair, but the structure shows a single bundle of vessels and therefore a single leaf. The ducts, always peripheral, vary greatly in number, from 2 or 3 to 12 or 14.

5. P. PARRYANA, *Engelm.* A small tree, 20 or 30 feet high and 10 to 18 inches in diameter, with a round top: leaves 3 to 5 (mostly 4) in the sheath, $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long: male flowers oval, with 4 involucral bracts in the axil of broadly oval acute bracts: cones subglobose, $1\frac{1}{2}$ to 2 inches thick, with strongly elevated knobs: seeds oval, 5 to 8 lines long, with a thin light-brown mottled shell: cotyledons 8. — Amer. Journ. Sci. 2 ser. xxxiv. 332, note; Parlat. l. c. 402. *P. Llaveana*, Torr. Bot. Mex. Bound. 208, t. 53.

Thus far found but once, by Dr. C. C. Parry, 40 miles southeast of San Diego, just across the boundary [125] line, at an altitude of 2,000 or 3,000 feet. One of the four nut pines, and distinguished from the last principally by the number of leaves in a sheath.

+ + Leaves in fives: cones ovate to subcylindrical, with numerous scales: seeds small, winged.

6. P. BALFOURIANA, *Jeffrey.* A medium-sized tree, seldom over 50 feet high and sometimes 5 feet in diameter, of regular pyramidal growth: bark red-brown, deeply fissured: leaves 1 to $1\frac{1}{4}$ inches long, rigid, curved, crowded, and appressed to the stem and persistent for 10 or 15 years: male flowers oval, a half-inch long, with 4 involucral bracts; anthers with a short irregularly denticulate crest: cones pendulous from the slender branchlets, subcylindrical, $3\frac{1}{2}$ to 4 or rarely 5 inches long, dark purple; apophyses thick, with short deciduous prickles: seeds pale, mottled, $3\frac{1}{2}$ to 4 lines long; wing 6 to 10 lines long, widest about the middle: cotyledons 5. — Gordon, Pin. 217.

Var. ARISTATA. Tree 50 to sometimes 100 feet high: anthers with scarcely a knob: cones ovate, with thinner scales, and with shorter recurved or slender awn-like prickles: seeds smaller, $3\frac{1}{2}$ lines long, the wings $3\frac{1}{2}$ to 5 lines long: cotyledons 6 or 7. — *P. aristata*, Engelm. l. c. 331, and Trans. Acad. St. Louis, ii. 205, t. 5, 6; Parlat. l. c. 400.

Alpine, on mountains near Mount Shasta (*Jeffrey*); on the flanks of Scott Mountains, forming a dark green belt from 5,000 to 8,000 feet altitude between the lighter colored *P. monticola* below and *P. flexilis*, var. *albicaulis*, above it (*Lemmon*); on the headwaters of King and Kern Rivers (*Brewer, Stegman*), and on Mount Whitney, *Rothrock*. The variety, with recurved prickles, on the Inyo Mountains (*Stegman*) and thence sparsely scattered on the higher mountains through Nevada, Northern Arizona, and Southern Utah; the form with awned scales in Colorado. Mr. Lemmon describes the bark as reddish brown; the Colorado form has reddish gray bark. The reddish wood is of extremely slow growth, hard and tough. Hypoderm cells surround the leaf and also the ducts, distinguishing the leaves from those of *P. flexilis*.

* * Resin-ducts parenchymatous: leaves serrulate, with stomata upon all sides; sheaths persistent.

+ Cones subterminal.

++ Leaves in fives.

7. P. TORREYANA, *Parry.* A small tree, 20 or 30 feet high and 12 to 15 inches in diameter: leaves crowded at the ends of the thick branchlets in the axils of lanceolate strongly fringed bracts, very stout, 8 to 11 inches long; young sheaths 15 to 18 lines long, old ones 6 lines long, cones ovate, 4 to $4\frac{1}{2}$ inches long by $3\frac{1}{2}$ thick, patulous or deflexed on peduncles an inch long; umbo short and stout or sometimes elongated and inflexed: seeds oval, 8 to 10 lines long, twice as long as the wing, which encloses the seed with a thick rim: cotyledons 13 or 14. — Bot. Mex. Bound. 210, t. 58, 59. *P. lophosperma*, Lindl. in Gard. Chron. 1860, 46; Parlat. l. c. 391.

On the coast of Southern California, from San Diego to San Pedro, buffeted by the sea winds and generally crooked and much defaced. The leaves are perhaps the stoutest of any known pine; seeds large and edible.

++ ++ Leaves in threes.

8. P. PONDEROSA, *Dougl.* One of the largest pines known (200 to 300 feet high and 12 to 15 feet in diameter), with very thick red-brown bark, deeply furrowed and split in large plates: leaves on stout branchlets in the axils of strongly fringed somewhat persistent bracts, 5 to 9 or even 11 inches long; the thin sheaths at first 9 or 10 (later 3) lines long: male flowers cylindric, flexuous, $1\frac{1}{2}$ to 2 inches long, crowded into a short head; involucre of 10 or 12 bracts; anthers with a large semicircular scarcely dentate crest: cones oval, 3 or 4 (rarely 5) inches long, $1\frac{1}{2}$ to 2 inches thick, of a rich brown color, sessile or subsessile, spreading or slightly recurved, often 3 to 5 together; umbo high, with a stout straight or incurved prickle: seeds dark brown, 4 lines long; wing 10 to 12 lines long, widest above the [126] middle: cotyledons 6 to 9. — Loud. Arbor. iv. 2243; Newberry, l. c. 36, t. 4; Parlat. l. c. 395; Engelm. Wheeler's Rep. vi. 261. *P. Benthamiana*, Hartw. Journ. Hort. Soc. ii. 189. *P. Beardsleyi* and *Craigana*, Murr. Edinb. New Phil. Journ. i. 286.

Var. JEFFREYI. A tree 100 to 200 feet high, with a more rounded top, more finely cleft and darker bark, and paler leaves 4 to 9 inches long; male flowers $1\frac{1}{4}$ inches long: cones larger, 5 to 12 inches long, lighter brown, on short

peduncles, fewer in a cluster, with thinner apophyses, and slender prickles hooked backward: seeds 4 to 7 lines long; wings 12 or 13 lines long: cotyledons 7 to 11. — *P. Jeffreyi*, Murr. l. c. xi. 224, t. 8, 9; Parlat. l. c. 393.

Var. SCOPULORUM. A smaller tree (80 to 100 feet high); leaves 3 to 6 inches long, often in pairs: male flowers an inch long: cones smaller, 2 or 3 (rarely 4) inches long, grayish brown, with stout prickles: seeds $2\frac{1}{2}$ to $3\frac{1}{2}$ lines long, the wings 9 to 12 lines: cotyledons 6 to 9. — *P. ponderosa* of the Rocky Mountain floras.

The widest spread western pine; the original form in California and Oregon, at low and high altitudes and even in the plains, often associated with *P. Lambertiana* and *Abies concolor:* the var. *Jeffreyi* usually on mountains above 5,000 feet altitude, especially on the eastern slope of the Sierra Nevada, where it is apt to grow in the most arid localities, ranging into Oregon. The third form is found throughout the Rocky Mountains. A magnificent tree, known throughout the west as the "Yellow Pine," and vying with the Sugar Pine and Sequoias, with very thick bark (in large trees 3 or four inches thick) and unusually thick sap-wood, which shows 100 to 200 annual rings before it becomes heart-wood. The latter is yellow, heavy, and very resinous. The var. *Jeffreyi* has often been considered distinct, but connecting forms are not rare; one of these is *P. deflexa*, Torr. Bot. Mex. Bound. 209, t. 56. The rows of stomata are often, but by no means always, more distant in var. *Jeffreyi* than in the typical form. The leaves persist about three years and are therefore always found brush-like at the end of the branchlets, except in young shoots. The parenchymatous ducts (2 or 3 or more) of all the forms are generally very small, and are always surrounded with some (often many) strengthening cells, which are also found within the sheath. *P. Jeffreyi* is one of several species (*P. Balfouriana*, *P. Murrayana*, *Abies Pattoniana*, etc.) which were collected by Mr. Jeffreys, and described by Prof. Balfour anonymously (with figures by Greville) in what is sometimes cited as the "Report of the Oregon Committee." The authority for the specific names is given variously by different authors; fortunately most of them may be referred to other species.

++ ++ ++ Leaves in pairs.

9. P. CONTORTA, *Dougl.* A low tree, 5 to 15 or rarely 20 to 25 feet high and 6 inches in diameter, with a rounded or depressed top and thin smoothish bark: leaves 1 to $1\frac{1}{2}$ inches long by half a line wide, strongly and closely serrulate; bracts scarcely fringed: male flowers cylindrical, $\frac{1}{2}$ inch long, in a spike 1 or 2 inches in length; the outer pair of the 6 involucral bracts nearly as long as the inner ones; anthers with semicircular crests: cones clustered, oval or subcylindric, very oblique, with strong knobs and delicate bristles, or rarely almost without knobs, very often serotinous (remaining closed for several or many years): seeds black, grooved, 2 lines long; wings 6 lines long, widest above the base, tapering upward: cotyledons 5, rarely 4. — Loud. Arbor. ii. 2292, and Encyc. 975, fig. 915. *P. inops*, Bong. Veg. Sitch. 45; Hook. Fl. Bor.-Am. ii. 161. *P. Bolanderi*, Parlat. l. c. 379.

Var. MURRAYANA. Much taller and straighter, 80 to 120 feet high and 4 to 6 feet in diameter, with a conical head and thin scaly light grayish-brown bark: leaves 1 to 3 (mostly about 2) inches long, $\frac{3}{4}$ to 1 line wide, light green, delicately serrulate; sheaths 4 to 6 lines long, or old ones 1 to $1\frac{1}{2}$: male flowers with 6 to 8 involucral bracts: cones very rarely lateral, less oblique, often opening at maturity and deciduous: wings of seeds longer. — *P. contorta*, Newberry, l. c. 34, t. 5, and of the Californian botanists; Parlat. l. c. 381, in part. *P. inops*, Benth. Pl. Hartw. 337. *P. Murrayana*, Murr. l. c. 226. *P. contorta*, var. *latifolia*, Engelm. in Bot. King Exp. 331; Porters, Fl. Colorado, 129; and Wheeler's Rep. vi. 262.

The original Douglasian *P. contorta*, which came from the mouth of the Columbia River, is a small narrow-leaved tree of the wet sandy coast of the Pacific from Mendocino to Alaska, a distance of perhaps 1,500 miles. Its narrow leaves, persistent and long-closed very oblique cones, which cover the tree so that sometimes scarcely any foliage remains visible, well characterize it. The variety is a common tree on the higher Sierra Nevada to an altitude [127] of 8,000 or 9,000 feet, extending into Oregon and in the Rocky Mountains southward to Colorado and Utah. In the Sierra Nevada the cones are more deciduous, but in Colorado they are as persistent as on the coast. Jeffrey's specimens on which *P. Murrayana* was based came from the high Sierras and are undoubtedly *P. contorta*, while *P. muricata*, with which they have been confounded, never occurs far from the sea and is otherwise very distinct.

P. MURICATA may be looked for here, as a form of it is found that seems to have sometimes terminal cones.

+ + Cones lateral.

++ Leaves in threes.

10. P. SABINIANA, *Dougl.* An open-branched round-topped tree, with rough ash-gray bark, slender glaucous branchlets and sparse foliage: leaves drooping, slender, light-green or glaucous, 8 to 12 inches long and half a line wide, their sheaths an inch long, or later but half that length; bracts deciduous: male flowers oblong, about 10 lines long, in an elongated spike; involucral bracts 10 to 15, the exterior pair minute; crest of anthers semi-orbicular: female ament on a peduncle $1\frac{1}{2}$ inches long: cone short-oval, acutish, massive, 6 to 10 inches long by 4 to 6 in diameter, deep mahogany-brown, persistent, with stout projecting apophyses and robust somewhat incurved points: seeds subcylindric, 9 to 12 lines long, dark; wing scarcely half as long, with broad rim: cotyledons 15 or 16. — Lamb. Pin. 1 ed. 146; Nutt. Sylva, iii. t. 113; Newberry, l. c. 39, fig. 13; Torr. Bot. Mex. Bound. t. 57.

Abundant, but scattered or in small groves, over the dry and hot hills of the Coast Ranges, in the Sacramento Valley, and on the foothills of the Sierra Nevada through the whole length of the State, not over 4,000 feet above the sea, and occasionally on their eastern slope (Owen's Valley, *Rothrock*). One of the "Nut Pines," and most important to the Indians, in appearance very different from all other pines.

11. P. COULTERI, *Don.* A tree 1 or 2 feet in diameter, with very thick rough and almost black bark : leaves crowded at the ends of the thick branchlets, stiff, erect, 6 or 8 to 10 or 11 inches long and $\frac{3}{4}$ line wide ; young sheaths $1\frac{1}{2}$ inches long, a half-inch when old ; bracts much fringed : male aments cylindric, 18 to 20 lines long, surrounded by 8 or 10 bracts, the outer half as long as the inner ; anthers crested : cones shortly peduncled, long-oval, pointed, 10 to 14 inches long and 4 or 5 thick, yellowish-brown, persistent many years ; scales with a broad elongated apophysis and a very stout long incurved point (sometimes 2 inches long) : seeds oval, slightly ridged, black, 6 to 8 lines long ; wing 10 to 15 lines long : cotyledons 11 to 14. — Linn. Trans. xvii. 440; Parlat. l. c. 392. *P. macrocarpa*, Lindl. Bot. Reg. xxvi. misc. 61.

In the Coast Ranges, at moderate elevations, from Monte Diablo to the southern border of the State. Wood brittle. Similar to the last species, but readily recognized by the thicker and stiffer branchlets and leaves. The cones are sometimes shorter and thicker than usual, with very short spurs, and may then be mistaken for those of *P. Sabiniana*, but the seeds and wings (or their impressions on the scales) will always distinguish them.

12. P. INSIGNIS, *Dougl.* A tree 80 to 100 feet high and 2 or 3 feet in diameter, with thick much-fissured bark : leaves 4 to 5 or rarely 6 inches long, slender (only half a line wide), very closely serrate, bright green, their bracts not fringed : male flowers oblong, half an inch long, in a spike 1 to $1\frac{1}{2}$ inches in length, and surrounded by 10 involucral bracts ; anthers small, crested : cones shortly peduncled, in clusters, deflexed, very obliquely short-oval, pointed, 3 to $5\frac{1}{2}$ inches long and 2 or 3 thick, deep chestnut-brown, very persistent and often remaining closed for many years ; scales on the outer side and especially toward the base enlarged, very thick and hemispherical, rarely flat, on the inner side flat and much smaller ; all at last nearly unarmed : seeds grooved and tuberculated, black, 3 or 4 lines long ; wing 8 to 10 lines long, widest above the middle : cotyledons 5 to 7.— Loud. Arbor. iv. 2243, fig. 2132–7 ; Torr. Bot. Mex. Bound. t. 55 (poor). *P. Californiana*, Lois. in Nouv. Duham. v. 243 ? *P. adunca*, Bosc ; Poir. in Lam. Dict. Suppl. iv. 418 ? *P. radiata* and *P. tuberculata*, Don, Linn. Trans. xvii. 441 (also earlier names, but only [128] based one on larger and the other on slenderer cones).

A tree peculiar to the sea-coast from Pescadero, south of San Francisco, to Monterey and San Simeon Bay, and known as the " Monterey Pine." Much interest attaches to the species, not only on account of its rapid growth and beautifully fresh green foliage, which make it ornamental in cultivation, but also because it is probably the old *P. Californiana*, which has never been identified but was said to have come from Monterey and to resemble in its cones the Mediterranean *P. Pinaster* and in its large seeds *P. Cembra*, such as we do not find near that town. *P. Sinclairii*, Hook. & Arn., Bot. Beech. 392, t. 93, is a factitious species founded upon a cone of *P. Montezumæ* (from Tepic) and the foliage of *P. insignis*, while *P. radiata* of the same authors, l. c. 392 and 443, is made up of the foliage of the former species and cone of the latter, as is proven by the specimens in Herb. Kew. A variety, *binata*, has been collected by Dr. Palmer on Guadalupe, with the normal cones of *P. insignis* but the leaves in pairs.

13. P. TUBERCULATA, *Gordon.* A small tree, 3 to 20 or exceptionally 30 to 40 feet high, $\frac{1}{2}$ to 1 foot in diameter, with a loosely branched conical top and thin light-brown roughish bark : leaves 3 or usually 4 to 7 inches long, $\frac{1}{2}$ to $\frac{3}{4}$ line wide, slightly and distantly serrulate ; sheaths at first 6 lines long ; bracts slightly fringed : male flowers in an elongated spike, cylindrical, 7 to 9 lines long, with 6 involucral bracts, the outer not much shorter than the inner ones ; anthers crested : cones in verticils of 2 to 4, several of which often form on the same year's shoot, pale leather-brown, at last silver-gray, persisting for many years often without opening, peduncled, strongly reflexed, 3 to 5 inches long by $1\frac{3}{4}$ to 2 inches thick, conic-cylindrical, pointed, very oblique at base; outer scales much enlarged conically, angular, the inner flat, all with sharp prickles : seeds black, grooved, 3 lines long; wing 7 or 8 lines long, widest at or above the middle : cotyledons 5 to 8. — Pin. 211 ; Parlat. l. c. 394. *P. Californica*, Hartw. Journ. Hort. Soc. ii. 189.

On the Coast Ranges from San Bernardino and the Santa Lucia Mountains to the Shasta region, and here and there on the foothills of the Sierra Nevada (Forest Hill, between the forks of the American River, at 2,500 feet altitude, *Bolander*). This Californian Scrub Pine is a small and unsightly tree or bush, which on the east side of Mount Shasta is found full of cones when only 2 or 3 feet high (*Brewer*). The name *P. tuberculata*, originally given to a form of the last species, was transferred to this after Jeffrey's discoveries in 1852, and having been so used invariably since should still be retained, inasmuch as Hartweg's name of *Californica*, though much older, was applied only through a mistaken identification of the species with Loiseleur's plant above mentioned, and must therefore be dropped.

++ ++ Leaves in pairs.

14. P. MURICATA, *Don, l. c.* A middle-sized tree, 25 to 50 or rarely 80 to 120 feet high, mostly slender (1 or 2 or rarely 3 feet thick), with reddish-brown roughish bark and a patulous top : leaves rigid, 4 to 6 inches long, $\frac{3}{4}$ to 1

line broad, strongly serrulate; bracts lightly fringed, subpersistent; sheaths 9 lines long, at length reduced to 1 line: male flowers oval, 6 to 8 lines long, in spikes an inch long; involucre half as long as the flowers, of 6 or 8 bracts, the outer as long as the inner: cones sessile, spreading or more or less recurved, in clusters of 4 to 7, often remaining closed and long-persistent, ovate and very oblique, chestnut-brown, 2 to 3½ (usually 3) inches long and 1½ to 2 inches thick; prickles short and stout or (in the southern form) making long straightish or incurved spurs on the outside: seeds 3 lines long, grooved and rough, black; wing 6 to 8 lines long, widest above the middle: cotyledons 4 or 5. — Torr. l. c. t., 54. *P. Edgariana*, Hartw. l. c. iii. 217.

Only near the coast, where it is exposed to the sea winds and fogs, to an altitude of 2,000 feet, from Mendocino, where it grows tallest (in peat-bogs), to Tomales Point (in the most sterile soil), Monterey and San Luis Obispo. In many respects similar to the last, but readily distinguished by the leaves being in pairs and by the short thick cones. The specimens collected at Tomales Point (*Brewer*, *Bolander*) have subterminal cones, but seem to differ in no other respect. The cones are said to persist over 30 years.

IX. REVISION OF THE GENUS PINUS,* AND DESCRIPTION OF PINUS ELLIOTTII.

From the Transactions of the St. Louis Academy of Science, Vol. IV. 1880.

No difficulty exists in the circumscription of the genus *Pinus;* floral unite with vegeta- [161]
tive characters to establish it so firmly and so plainly, that nobody fails to recognize the species belonging to it. But when we come to analyze and to group the 60 or 70 species of pines which are known to us, we find that they appear so similar, that all attempts to arrange them satisfactorily have failed. The most obvious distinctive character was found in the number of leaves in each bundle, and thus the sections of 2-leaved, 3-leaved and 5-leaved pines were the only ones known to the older botanists. Spach (Syst. veg. 1834) separated *Cembra* on account of its "wingless" seeds; Link (Linnæa, 1841) relied on the number of leaves only, adding two sections, one with 2 or 3, the other with 3 or 4 leaves in a sheath; Endlicher (Synopsis, 1847) was the first to point out the form of the cone-scales as an important character, and his first two sections, *Cembra* and *Strobus*, were by the form of this scale distinguished from the other Pines; he retained the character of the "large wingless" seeds, to separate by it *Cembra* from *Strobus*, and *Pinea* from the other two-leaved pines which constituted his section *Pinaster*. Later writers did not add anything to our knowledge of the systematic relations of pines: Carrière (Conifères, 1855) copied Endlicher, and Gordon (Pinetum, 1858) went back to the mere number of leaves to characterize the sections. Ten years later Parlatore (DeCand. Prod. xvi. 2, 1868) followed Endlicher in adopting the differences in the form of cone-scales as the most valuable character, and advanced a step further by discarding the proportionate size of the seeds as of sectional value. He divided his subgenus *Pinus* in two sections, *Pinea* with pyramidate and *Cembra* with dimidiate apophyses. The subsections of his *Pinea* were again based on the number of leaves, in twos, in threes, or in fives in each bundle; those with single leaves, with 2 or 3, and those with 3, 4 or 5 leaves had to find their place as best they could.

Not satisfied with such superficial knowledge of this interesting and important genus of [162]
trees, I have for a number of years devoted my leisure hours to the careful study of the different species accessible to me. In the following pages I give the principal results of my investigations.

Size. Almost all the pine species grow up to be trees; the only shrubby one known to me is *Pinus montana*, heretofore known as *P. Pumilio;* a few make small, insignificant trees, such as *P. tuberculata;* the nut pines, or cembroid pines, never grow large, but several others attain the greatest dimensions; *P. Lambertiana* grows to the height of 300 feet, with 20 feet in diameter, and

* The account of this genus in Gray's Manual, 5 ed. 1868, pp. 469–470, is based on notes contributed by Dr. Engelmann. The article "Pinus" (in the Linnæan sense) in Johnson's new Illustrated Universal Cyclopædia, New York, 1877, Vol. III. pp. 1256, 1257, is also from his pen. — Eds.

P. ponderosa (at least in California) comes very near it; these two are probably the largest pines known.

The AGE of pines varies between 15 to 25 years (*P. tuberculata* and perhaps *P. montana*), 300 years (*P. mitis, P. ponderosa, P. Balfouriana*), and 500 to 600 years (observed in *P. monticola* and *P. Lambertiana*).

The BARK in some species is thin, only a few lines thick, flaky and detached in scales (*P. contorta, P. resinosa*); in others (e. g. *P. ponderosa*) it is several inches thick, persistent, rough, and deeply cracked. It is gray in some species, e. g. in the nut-pines, but most commonly of a brown red or cinnamon color, or sometimes deeper brown; in *P. Australis* and *P. Elliottii*, especially in the latter, it is laminated, the external layers peeling off in thin plates.

The WOOD grows rapidly, especially during the first (often the first 50) years of their age, so that annual rings are sometimes 2 or 3 lines thick; in *P. glabra* I have seen them even 6, in *P. insignis* 5 and in *P. rigida* var. *serotina* 4 lines thick; in old age or in the short seasons of high altitudes the wood grows so slowly that sometimes ten annual rings make not more than the thickness of one line.

The sapwood is always white, and it takes many years before it turns into perfect or heart-wood: in *P. ponderosa, Lambertiana,* and *mitis* sometimes 100 or even 150 years; in others, e. g. *P. flexilis* and *Sabiniana* not more than 20 or 30 years; but the majority of pines which I have examined may require 50 or 60 years to mature their heartwood. In many other trees this process takes about 20 or 30 years, in most oaks on an average about 20 years, in *Catalpa* not more than [163] 2 or 3 years. The thickness of the sapwood in pines is usually 2–4 inches, and rarely under 1 inch; in *P. ponderosa* I have found it sometimes even 10 inches.

The wood cells and especially those more compact ones of the late summer growth, the outer part of the layers, are often strongly impregnated with resin and thereby darker colored, yellowish or brown, and become in thin sections semi-transparent; this is much more the case in those of the section *Pinaster* than of *Strobus*. The former have mostly heavier and harder wood than the latter, though we find exceptions, such as *P. contorta*, which has soft wood similar to that of the white pine or spruce. Spirally marked cells, such as abound in *Pseudotsuga* and in *Taxus*, have not been found in the pines.

The LEAVES, in the wider sense, are of seven different forms: the cotyledonous or seed-leaves, the primary leaves, the ordinary bracts, the secondary leaves, the bracts constituting the sheath of these, the bracts forming the involucrum of the male flowers, and the bracts supporting the carpellary scale.

The COTYLEDONOUS LEAVES form a whorl of 4 to 18 in number, are triangular, flat on the back, keeled above, higher than broad and mostly entire; in *P. Strobus* I find the keel slightly spinulose-dentate. Stomata are found only on the inner and upper sides, as is the case in the cotyledonous leaves of most conifers; those of *Sciadopitys* are, as far as I know, the only ones that have stomata merely on the under and none on the upper side.

The PRIMARY LEAVES succeed the cotyledons on the main axis; in some species (*P. inops, P. rigida, P. Canariensis*, etc.) they are also found on the sprouts. They are always subulate from a broader base, flat, keeled on both surfaces, always serrulate, even in those species whose secondary leaves are entire (*P. edulis*), with stomata in rows on both surfaces, more on the lower than on the upper face.

The primary leaves not rarely produce in their axils buds with secondary leaves, but they are most generally reduced to BRACTS (*Hochblaetter*) before their axils become productive. These bracts are triangular-lanceolate, membranaceous or coriaceous, entire or mostly fringed on the [164] edges, more or less persistent or mostly deciduous, sometimes articulated above their base.

The SECONDARY LEAVES constitute the foliage of the tree: they are borne on an undeveloped

branchlet in the axils of primary leaves or mostly of bracts, and are surrounded at base by a sheath of bud-scales (*Niederblaetter*). These consist of 2 short, rigid, strongly keeled, lateral bracts and a number (6–10 or more) of longer, thinner inner ones, which generally are woven together by the delicate fringes of their edges, and are then persistent with the leaves, though in time worn off at the ends; or they are loose, at last spreading and deciduous at the end of the first season. This is the case in all the species of the section *Strobus*, in the nut-pines, and in a few others: *P. Balfouriana, Gerardiana, Bungeana, Chihuahuana,* and usually also in *P. leiophylla*.

The secondary leaves generally occur in definite numbers, 1 to 5, in a bunch, or their number is slightly variable: some species have regularly 2 and 3 leaves (*P. mitis, P. Elliottii*), others vary with 3 to 5 leaves (*P. Montezumæ*); species with regularly 3 leaves have occasionally 2 or 4, such with 5 leaves are sometimes found with 6 and even 7 leaves. Where we have one (only in *P. monophylla*), the leaf is terete; where there are two, the leaves are semi-terete, convex on the lower surface and flat on the upper one when fresh, or channelled when dry. Those leaves that grow in bundles of 3 or more are triangular, the upper surface being more or less elevated and keeled; ternate leaves are generally somewhat flatter, and quinate ones higher and regularly triangular. Thus the shape of the leaf and especially its transverse section is mostly sufficient to determine the number in which they occur.

The leaves are in most species minutely but sharply serrulate on the edges, and mostly also on the keel of the upper surface. These serratures are closer together, or more distant, coarser or more delicate, but are absent only in a very few West-American species: the *cembroid* or nut-pines, *P. Balfouriana,* and most forms of *P. flexilis*. The tips of the leaves are generally entire, acute, or acuminate, rarely obtusish; but in all the species of the section *Strobus* they are in the young and fresh leaves finely denticulate.

The stomata are usually distributed in longitudinal rows over both surfaces in the *Pinaster* [165] section; only *P. Balfouriana* has none on the back, and thus approaches *Strobus* in this as it does in many other respects. In *Strobus* we find on the back no or but few stomata, or sometimes a single or an interrupted line of them. *P. Lambertiana* only has numerous stomata on the back, thus approaching *Pinaster*.

I will have to dwell somewhat extensively on the internal structure of the leaves, as it proves to be of the greatest importance for the classification of the species. We distinguish in a transverse section the thick epidermis, the chlorophyll-bearing parenchyma cells, and in the centre the fibro-vascular bundle. This latter is single in the terete and mostly in the quinate leaves; it is double in the broader triangular or ternate, and in the semi-terete or binate leaves. This difference, however, is of very little diagnostic importance, as we find occasionally single or double bundles in the same species. The fibro-vascular bundles always show wood cells on the upper or ventral, and bast cells on the lower or dorsal side, traversed by delicate medullary rays, usually obliquely diverging from the lower to the upper side. The bundles are imbedded in a mass of small (medullary ?) cells, free of chlorophyll, and are together with those surrounded and separated from the parenchyma by a sheath of larger cells, also destitute of chlorophyll.

Within the parenchyma of the leaf a smaller or larger number of longitudinal tubes or ducts are found, the RESIN-DUCTS, normally probably two, but very often more, even as many as a dozen or more. These ducts occupy a certain definite position within the leaf. They lie (1) close to the epidermis, *peripheral ducts,* in some species more on the ventral, in others more on the dorsal side of the leaf; or (2) they occupy a place within the parenchyma and surrounded by it on all sides, *parenchymatous ducts;* or (3) they lie close to the sheath which surrounds the vascular bundles, *internal ducts.* This position of the ducts is so constant, and seems to be so intimately connected with the essential character of the plant, that I venture to adopt it as one of the principal characters for the subdivision of the genus. I must add, however, that in some few species smaller, accessory ducts do

sometimes occupy an abnormal position. Thus I find occasionally in some *Strobi*, especially in *P. excelsa*, where there are mostly two peripheral dorsal ducts, a third upper parenchyma- [166] tous one; in *P. Bungeana*, which generally has numerous peripheral ducts all around, occasionally a single lateral parenchymatous duct is observed; *P. Canariensis* has regularly parenchymatous ducts, but sometimes they are connected with the epidermis by a very thick bundle of strengthening cells (of which presently); *P. Laricio* has normally parenchymatous ducts, but in a specimen of var. *Pyrenaica* from the Pyrenees in Herb. Cosson I find them sometimes almost touching the epidermis cells, and therefore easily mistaken for peripheral. In *P. rigida* and *Tæda*, and also in *P. pungens* and *filifolia*, which all have normally parenchymatous ducts, I occasionally have observed a number of smaller accessory ducts close to the sheath of the vessels. In pines with very slender leaves it is sometimes difficult to discover the ducts, and in some forms they are, I believe, really absent, especially in cultivated specimens. Such may give us some trouble in their classification.

A peculiar element in the structure of the pine leaves is certain cells which had been formerly named "hypoderm cells;" but as they also occur in other parts of the leaf apart from the epidermis, they more appropriately receive the name of STRENGTHENING CELLS. They are thick-walled, elongated, colorless cells, much larger than the bast and wood cells, generally of the diameter of the epidermis cells, rarely a little larger, often smaller, and always smaller than the cells of the parenchyma. They give to the leaf its rigidity, and are most abundant in the most rigid pine leaves; in the softer more flaccid ones they are almost entirely wanting. Thus they are scarce or entirely absent in some species of the *Strobus* section; in *P. Pseudostrobus* and *P. filifolia* they are very imperfectly developed. The strengthening cells are principally found under and close to the epidermis (whence the name hypoderm cells) either in a continuous layer or mostly in bundles, interrupted by the lines of stomata; they are generally most abundant within the angles of the leaves. Sometimes they surround the ducts, and in all the species allied to *P. resinosa* and *P. sylvestris* they are found only there, and not or scarcely at any other places. In some species these cells also occur within the sheath, above and below the fibro-vascular bundles. Their presence and position are not absolutely constant, but may be relied on to some extent for diagnostic purposes. Thus [167] the quinate smooth-edged leaves of *P. flexilis* and *P. Balfouriana*, which would be difficult to distinguish without their cones, may be readily recognized by the strengthening cells, which in the latter surround the more closely approximating ducts, while in the former the ducts, widely apart from one another, are destitute of these cells.

The PERSISTENCE of the leaves is very different in different species; in *P. Strobus* and others they fall in the autumn of the second year; more commonly they last to the end of the third year; in some species, e. g. *P. Banksiana*, they do not fall before they are 4, 5, or even 6 years old; in *P. Balfouriana*, or at least in var. *aristata*, I have seen them persist 12 to 14 years. When the leaves persist only a short time and are long, and the annual growth of the axis is short, they form brushes or tassels (*P. australis*) at the end of the branchlets, but where they are short and persist long (*P. Balfouriana*) they give the branchlets that "fox-tail or bottle-brush" appearance of which travellers speak. In young and vigorous trees the leaves are apt to persist longer than in old ones.

In exceptional cases and as a monstrosity the leaf-bundles become proliferous, the branchlet which bears the secondary leaves elongating and forming a regular branch.

The pines are monœcious trees which bear their male and female flowers generally on different branchlets, the male commonly on the lower, the female frequently on the upper part of the tree; sometimes both are found on the same axis, the male below, the female above.

The MALE FLOWERS are borne on the lowest part of the year's shoot, in the axil of bracts, either crowded together in a kind of a head or elongated in a spike; the axis usually continues to elongate during or after flowering and makes a leafy branch, which in its continuation in succeeding years

often again bears flowers. Male flowers sometimes abnormally make their appearance higher up on the axis mixed with leaf-bundles and occupying the place of such. The male flowers consist of an indefinite number of anthers sessile on a more or less elongated column, and have the form of an oval or a cylindrical ament, for which they used to be taken. They are surrounded by a somewhat definite number of bracts, which assume the functions of a calyx and have been sometimes designated as such. Linnæus, in his Syst. Nat. ed. 1, speaks of a *calyx 4-phyllus.* [168] Their number varies in the different species from 3 to 15 or 16, but is fairly constant in the same species. The two exterior lateral bracts are strongly keeled, like those of the sheath of the leaves, and stouter and mostly shorter than the others; the third is placed on the upper side, towards the axis of the inflorescence; the fourth on the lower or dorsal side, opposite the supporting bract, and so forth. The innermost ones not rarely exhibit a transition to the anthers, bearing small or incomplete anther cells on the lower part of their back. In *P. resinosa* and *Canariensis* I find the involucral bracts articulated in the middle.

A table exhibiting the numerical proportion of involucral bracts in the different species, the male flowers of which I could examine, may not be without value.

3 or 4 involucral bracts I find in *P. sylvestris* and *Pinaster;*
3 to 6 in *P. densiflora;*
4 in *P. Balfouriana, Canariensis,* and *Greggii;*
4 to 5 in *P. edulis* and *Parryana;*
4 to 6 in *P. Pinea* and *P. Halepensis;*
4 to 10 in *P. Pyrenaica;*
5 to 6 in *P. monophylla;*
6 in *P. leiophylla, Laricio,* and *contorta;*
6 to 7 in *P. resinosa, montana,* and *Massoniana;*
6 to 8 in *P. Strobus, excelsa, Peuce, Cembra, rigida, tuberculata, muricata, pungens, Banksiana;*
8 to 10 in *P. monticola, flexilis, insularis, Chihuahuana, Thunbergii, Laricio* var. *Pyrenaica,* and *Austriaca, Coulteri, inops;*
8 to 12 in *P. Tæda;*
9 to 12 in *P. Montezumæ* and *mitis;*
10 in *P. insignis;*
10 to 12 in *P. ponderosa;*
10 to 15 in *P. Sabiniana;*
12 in *P. Merkusii* and *Elliottii;*
12 to 14 in *P. Khasia, glabra,* and *australis;*
14 to 16 in *P. Lambertiana* and *Cubensis.*

The ANTHERS consist of two parallel extrorse cells, which open longitudinally on their back; their connective, heretofore often called a bract, spreads out into a transverse semi-orbicular or almost orbicular, entire or denticulate (in most species of *Pinaster*) or lacerate (*P. Lambertiana*) [169] crest, or it terminates in a knob or a few teeth (in most *Strobi* and a few *Pinasters* such as *P. Balfouriana* and *sylvestris*).

The POLLEN has the well known bilobed form, consisting of an elliptic central portion, which emits the pollen tubes, and two lateral sacs which are said to contain air. The longer diameter measures 0.025 to 0.045 line, mostly between 0.030 and 0.040 line, while the pollen-grains of *Abies* and *Picea* are much larger and in many instances twice as large, viz. 0.045 to 0.070 line long. Thus by the pollen alone *Pinus* can generally be distinguished from those allied genera. The different species of pines are pretty constant in the size of their pollen.

Without going into minute detail, I will only state that I find pollen-grains of

0.025–0.030 line in *P. edulis* and *P. Banksiana;*
0.030–0.035 " in *P. Balfouriana, sylvestris, montana, resinosa, Chihuahuana, Laricio, inops, contorta;*
0.035–0.040 " in *P. Strobus, excelsa, Pinea, rigida, Tæda, mitis;*
0.040–0.045 " in *P. Lambertiana, flexilis, Montezumæ, Pinaster, ponderosa, Sabiniana, Elliottii.*

The property of the pine-pollen to float for a long time in the air, and to be carried by storms to very distant localities, is well known. I have found in streets of St. Louis after a rainstorm from the south, in March when no pines north of Louisiana were in bloom, pine-pollen which must have come from the forests of *P. australis* on Red river, a distance of about 6½ degrees of latitude or 400 miles in a direct line.

The FEMALE FLOWER consists, as in all *Abietineæ*, of a carpellary scale in the axil of a smaller, concealed bract, bearing two pendulous ovules on the lower part of the upper side. A number of such scales in the axils of their supporting bracts, and spirally arranged, form the female ament. The question of the nature of the scales, and of the ovules they bear, is not to be discussed here, but it may be stated that the best lights force the view on us that the carpellary scale consists morphologically of two leaf-organs, lateral to an undeveloped axis and united at their posterior edges (those turned towards the axis of the ament), and thus bearing their naked ovules on their morphologically outer but now reversed and *apparently* upper side.

The carpellary scales, which in the flower as well as in the fruit we call, in short, *scales,* [170] are either rounded, obtuse, and appressed (in *Strobus,* etc.), or they have a short (*P. resinosa, sylvestris,* etc.) or a longer (*P. ponderosa, Tæda*) or an elongated subulate, often squarrose, point (*P. contorta, inops, pungens*).

The aments are globose, oval or elongated, subsessile or peduncled, single or several together, always erect, each borne in the axil of a bract, its base invested by sterile bracts which gradually or suddenly give place to the carpel-bearing bracts, just as the involucral scales of the male flowers give place to stamens. They make their appearance on the upper part of the year's shoot, often just below the terminal bud, when we call them *subterminal;* or they become *lateral,* when the axis elongates beyond them, and sometimes more aments form above them in the same season. The axis above the aments continues covered with leaf-bundles in some, while in others it is naked for some distance, or rather destitute of leaves, bearing only bracts; a second stage of aments or the terminal bud is always preceded by a number of leaf-bundles.

The position of the female ament, whether subterminal or lateral, seems to be connected with an essential difference in the species of pines, secondary in importance only to the leaf structure as described above, and both of these together will enable us to arrange the species in something like a natural order. It ought to be understood, however, that the relative position of the ament on the axis is not absolute and that variations do occur. Species with ordinarily subterminal aments may in young and vigorous shoots sometimes bear lateral aments; this occurs, though very rarely, in *P. ponderosa* and *australis,* and perhaps in others, but I have never seen it in any of the *Strobus* section, nor in *P. sylvestris, resinosa, Laricio,* or its allies. More frequently subterminal aments are found in species which normally bear lateral ones, probably when with the formation of the aments the vigor of the axial growth has been exhausted; thus sometimes a second stage of aments is subterminal, while the first is of course lateral; or subterminal and lateral ones are occasionally found on different branches of the same tree; or, very rarely, a tree bears almost entirely subterminal aments. This last case I have seen in the Californian *P. muricata* and in the Mediterranean [171] *P. Pyrenaica.* This character has to be studied intelligently among the native trees in their homes. So long as only a few herbarium specimens can be consulted it must remain doubtful, and errors may creep in, especially as collectors have heretofore paid so little attention to the necessity of obtaining instructive specimens, which, however, are easily procured in any season of the year, provided the tree bears at all; for always either flowers or young cones, or in spring both together, can be obtained.

The compound FRUIT resulting from these aments, known as the *cone* or *strobile,* matures at the end of the second, or in a single species, *P. Pinea,* of the third season; during the first twelve months

it does not enlarge much; in most species it retains its erect position during that period, but in a few it becomes reversed soon after flowering and before the leaves are developed (*P. sylvestris* and *Elliottii*); in the allies of *P. Strobus* the slender peduncle bends downwards in the second summer apparently by the weight of the swelling cone; but in the majority of the species the cones in that period assume a horizontal or somewhat declined, rarely a strictly recurved, position. Only in *P. Banksiana* it is as often curved upwards as horizontal. We continue to speak of subterminal and of lateral cones in regard to that part of the axis which bore the flowers, though the branch elongates in the next year, and the maturing cone, strictly speaking, thus always becomes lateral.

The cones are, as the name might indicate, conical, from subglobose to oval or subcylindrical, mostly more or less symmetrical, often slightly oblique, and in some Californian and Mexican species (*P. insignis, tuberculata, muricata, patula*) so much so, that the scales on the inner and the outer side become very unequal; in the first named species especially we find the scales on the outer, convex, side much larger and tumid; on the inner, more flat, side smaller and depressed, but singularly enough more fertile than the big outer ones. The color of the cones is from gray to light leather-brown, reddish, or deep brown, with a dull or a glossy or almost varnished surface. They vary in length from $1\frac{1}{2}$ or 2 to 12 or even, in *P. Lambertiana*, to 18 inches.

The phyllotactic arrangement of the scales is quite interesting, but not of much diagnostic [172] importance; nevertheless it will be necessary in the description of the different species to mention it, and also to state the number of the more prominent secondary spirals, two of which, inclining in opposite directions, are always the most conspicuous. The long cones of *P. Strobus, excelsa*, and *Ayacahuite*, and the short ones of *P. edulis* and *monophylla*, show the $\frac{8}{13}$ order of scales, and the 3 and 5 spirals are the most prominent ones. *P. Lambertiana* and *Sabiniana* have the $\frac{3}{5}\frac{4}{5}$ arrangement with the 8 and 13 or the 13 and 21 spirals most conspicuous. The intermediate orders of $\frac{1}{2}\frac{3}{1}$ and $\frac{2}{3}\frac{1}{4}$ are the most common ones; abnormal orders are extremely rare.

The cone scales furnish us the most valuable characters for the classification of the species. Their exposed part, not covered by adjoining scales and more or less thickened, has been called the *apophysis;* it is rather depressed and terminates in a blunt point in the section *Strobus;* in *Pinaster* it bears its point on the usually more thickened back, the *umbo*, mostly armed with a prickle, weak or strong, early deciduous (in *P. Balfouriana, insignis, Banksiana*) or stout and persistent (in *P. rigida, Tæda, inops, pungens*); in some species (*P. Sabiniana, Coulteri*) it becomes a thick, long, and often curved or twisted spur.

The bracts which support the scales remain concealed, but become greatly enlarged and mostly thickened and corky, and help to form lodges for the seeds, which are enclosed between them and the scales.

The cones generally open their scales soon after maturity, drop their seeds, and fall off soon afterwards; in most cases they separate at the insertion of the peduncle, but in a few instances (*P. ponderosa, P. australis*) the peduncle and the lowest part of the axis together with a number of scales remain on the branch. In some species (*P. Sabiniana, Coulteri*) the open cones persist for several years on the tree, and in others they remain almost indefinitely, so that they are apt at last to be partially enclosed in later layers of wood. Such are *P. Banksiana, inops, pungens, insignis, muricata, rigida*, and some Mexican species. Most specimens of *Pinus contorta* retain their cones in this manner, while those of the higher sierras of California are early deciduous, proving that this character is not of great specific importance. The persistence of the cones may be connected with the peculiarity of some species to retain their seeds in temporarily or permanently closed cones, [173] when they are called *serotinous*. Such are southern forms of *P. rigida* (var. *serotina*) and *P. inops* (var. *clausa*), rarely *P. Tæda;* in some Californian (*P. insignis, tuberculata, muricata*) and Mexican species (*P. patula, Teocote* and *Greggii*) this is still more conspicuous. The seeds of such

serotinous cones seem to retain their germinating power for many years longer than loose pine seeds, which are known soon to lose their vitality.[1]

The SEEDS are obovate, or often more or less obliquely triangular, rarely (in *P. Sabiniana* and *Gerardiana*) nearly cylindrical, generally somewhat compressed, 2 to 12 lines in length, smooth or often on the lower surface ridged or slightly tuberculated, always destitute of balsam vesicles, pale gray or yellowish, or spotted, or brown, and often black. A wing is always present, and is generally several times longer than the seed; in some large-seeded species (*P. flexilis, Cembra, edulis,* and the other nut-pines, and *Pinea*) it is reduced to a narrow rim, which is apt to remain attached to the scale when the seed is liberated; in *P. parviflora, Bungeana, Gerardiana, Torreyana,* and *Sabiniana,* it is more conspicuous, but shorter than the seed itself; in *P. Coulteri* it is about as long as the seed, and in *P. Lambertiana* longer. The size of the seed and the proportion of the wing to it has been considered to furnish valuable sectional characters, but it proves to be only of specific importance. The wing is always more or less oblique and widest in some species upwards, in others near the base. The base of the wing forms a rim which surrounds the seed, leaving its under side free and with its edge covering part of, or rarely the greater part (*P. Elliottii*) or the entire upper side (only seen in *P. Banksiana*). Generally the wing and its rim is completely separable from the mature seed, but in a few species (*P. Strobus* and allies) it adheres to it closely, and is at last broken off irregularly.

The COTYLEDONS, 4 or 5 to 15 or 18 in number, are mostly several times shorter than the caulicle, usually not longer than its diameter, and rarely as long or a little longer than it; this [174] seems to be the case especially where the leaves also are of unusual length, e. g. in *P. australis.*

It is easy enough and very satisfactory to ascertain the number of cotyledons where a large quantity of seedling pines is at one's disposal. With me this was unfortunately not the case; hence I had to examine the seeds themselves, quite a laborious process, rarely extending over more than six or eight specimens, and often less. In examining greater numbers more variation will probably be discovered. As it is, the different species show a tolerable constancy in the number of their cotyledons. I give here only the result of my own observations, leaving out those found in the books. I have observed —

about 5 cotyledons in *P. Balfouriana, montana* (3–6), *Laricio, rigida, inops* (4–6), *muricata* (4–5), *glabra* (5–6), *Banksiana* (4–5);
about 6 cotyledons in *P. Balfour.* var. *aristata* (6–8), *resinosa* (6–7), *sylvestris* (6–8), *insignis* (5–8), *tuberculata* (5–8), *Tæda* (5–8), *pungens* (7), *Pinaster* (5–8), *mitis* (4–7);
about 8 cotyledons in *P. Strobus* (7–11), *monticola* (6–9), *parviflora* (8–10), *flexilis* (8–9), *monophylla* (7–10), *edulis* (7–10), *Parryana, Halepensis* (6–9), *ponderosa* (6–11), *Canariensis, australis* (7–10), *Elliottii* (6–9);
about 10 cotyledons in *P. excelsa* (8–12), *Peuce* (9–10), *Cembra* (9–12), *cembroides* (9–12), *Bungeana* (11);
about 12–15 cotyledons in *P. Ayacahuite* (12–14), *Lambertiana* (12–15), *Pinea* (10–14), *Torreyana* (13–14), *Sabiniana* (12–18), *Coulteri* (10–14).

In germination the seed-shell is raised like a hood on the tip of the cotyledons, mostly after the wing has come off, but sometimes the wing is raised high above the plantlet (*P. australis*). The axis generally soon elongates, bearing the primary leaves, but the species just mentioned behaves peculiarly in this period, almost as do many monocotyledonous trees. For six or eight years it grows not in length but only in thickness, and bears in the axils of the short primary leaves numerous tufts of long and slender secondary leaves, which give the plantlet the appearance of a coarse grass or a rush; only after it has acquired sufficient vigor the thick axis rapidly shoots up.

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[1] Seeds from closed cones of *P. contorta*, two to eight years old when I collected them in Colorado, and then kept four years in a hot garret, germinated freely with Prof. Sargent of the Arnold Arboretum, Mass.

I now propose an arrangement of the species of *Pinus* based upon the more essential [175] characters above analyzed, and, though I by no means claim it to be a faultless one, I expect that it will deserve the character of a natural one as much as any that can be devised. I find with Endlicher the most valuable character in the fruit scale, or rather, to speak more correctly, I find that the form of the fruit scale in this genus corresponds with a series of other characters which constitute two very natural sections of the genus. My section *Strobus* in a wider sense includes his *Strobus* and *Cembra*, and my *Pinaster*, also enlarged, comprises all his other sections, viz. *Pseudostrobus*, *Tæda*, *Pinaster*, and *Pinea*. The subsections are distinguished by the position of the ducts within the leaf, whether peripheral, parenchymatous, or internal. Subordinate to this character is the subterminal or lateral position of the female ament and the cone. Only after this may the number of leaves in a sheath be taken into consideration, and perhaps the presence or absence of strengthening cells around the ducts. It will be found that thus not only natural but to some extent even geographical alliances are best preserved. I enumerate only such species or subspecies (these in brackets) which I have been able to examine myself; the list, however, will be found nearly complete. The nomenclature of Parlatore in DC. Prod. xvi. [2] is adopted unless otherwise stated.*

Sect. I. STROBUS. Apophysis with a marginal unarmed umbo, generally thinner; cones subterminal; leaves in fives, their sheaths loose and deciduous; anthers terminating in a knob, or a few teeth, or in a short incomplete crest; wood softer, lighter, less resinous.

§ 1. Eustrobi. Ducts peripheral. — Northern or mountain species of the Old and New World.

* Wings longer than the seeds; leaves sharply serrulate, denticulate at tip.

† Strengthening cells few, none around ducts.

P. Strobus, *monticola*, *excelsa*, *Peuce*,[1] *parviflora*,[2] *Bonapartea*,[3] *Ayacahuite*.

† † Strengthening cells abundant under the epidermis and surrounding ducts.

P. Lambertiana.

* * Wings much shorter than seeds; leaves mostly entire, not denticulate at tip.

P. flexilis, (*albicaulis*), *pygmæa*.

§ 2. Cembræ. Ducts parenchymatous; leaves sparingly serrulate, scarcely denticulate at tip. — Europe [176] and principally Asia.

P. Cembra,[4] *Mandschurica*, *Koraiensis*.

Sect. II. PINASTER. Apophysis with a dorsal umbo, mostly armed, generally thicker; leaves 1 to 5 in a bundle, their sheaths usually persistent; anthers mostly terminating in a semi-orbicular or almost orbicular crest; wood generally harder, heavier, and more resinous.

A. Ducts peripheral.

a. Cones subterminal.

§ 3. Integrifoliæ. Leaves smooth-edged, their sheaths deciduous; anthers terminating in a knob or a few teeth. — Western North America and Mexico.

* Cones short subglobose, with thick scales, unarmed; seeds large with a minute wing; leaves 1 to 5. *Cembroides*.

P. Parryana, *cembroides*, *edulis*, *monophylla*.[5]

* * Cones oval or elongated, scales armed with a deciduous or persistent prickle or an awn, seeds much shorter than the wing, leaves in fives. *Balfouriana*.

P. Balfouriana,[6] (*aristata*).

§ 4. Sylvestres. Leaves serrulate, their sheaths persistent; anthers crested or (only in *P. sylvestris*) merely knobbed. — Europe and Asia, one species in America.

* Leaves in threes; wings much longer than seeds. *Indicæ*. — East India and its islands.

P. Khasia,[7] *insularis*,[7] *longifolia*.[7]

* This synopsis is reprinted in the *Gardeners' Chronicle* for July 24, 1880, p. 104. — Eds.

* * Leaves in twos; strengthening cells abundant, principally around ducts; fructification biennial, cones and seeds small, wings large. *Eusylvestres.* — Old World, one species in Northeastern America.

P. sylvestris,[8] *montana*,[8] *resinosa*,[9] *densiflora*,[10] *Massoniana*,[11] ? *Merkusii*.[12]

* * * Leaves in twos; strengthening cells under the epidermis and around ducts; fructification triennial, cones and seeds large, wings rudimentary. — A single Mediterranean species.

P. Pinea.

b. Cones lateral.

§ 5. HALEPENSES. — Old World.

* Leaves in threes, their sheaths deciduous; umbo very prominent; wings shorter than the large seeds. *Gerardianæ.* — Asia.

P. Gerardiana,[13] *Bungeana.*

* * Leaves in twos, their sheaths persistent; cones smoothish; wings much longer than the seeds. *Euhalepenses.* — Mediterranean regions.

P. Halepensis,[14] *Pyrenaica*.[15] [177]

B. Ducts parenchymatous.

a. Cones subterminal.

§ 6. PONDEROSÆ. — Mostly American, with three Old World species.

* Leaves in fives, ducts usually free of strengthening cells. *Pseudostrobi.* — Central America and Mexico to Arizona and California.

P. leiophylla,[16] *tenuifolia, filifolia*,[17] *Pseudo-Strobus, Montezumæ* [18] (*Hartwegii*), *Torreyana*, [19] *Arizonica*.[20]

* * Leaves in threes, sometimes in fours or fives, their sheaths persistent; strengthening cells under the epidermis, around ducts, and usually also near the fibro-vascular bundles. *Euponderosæ.* — Northwestern America, Mexico, and Canary Islands.

P. Engelmanni, [21] *ponderosa* [22] (*Jeffreyi*), *Canariensis*.[23]

* * * Leaves in threes, their sheaths deciduous. — Mexico and Arizona.

P. Chihuahuana.[24]

* * * * Leaves in twos, generally with some strengthening cells around ducts. *Lariciones.* — Europe to Asia and W. America.

P. Laricio [25] (*Austriaca*), *Thunbergii*,[26] *contorta* [27] (*Murrayana*).

b. Cones lateral.

§ 7. TÆDÆ. — Mostly American, only one Old World species.

* Leaves in threes, ducts mostly without strengthening cells. *Eutædæ.* — North America to Mexico.

P. Sabiniana,[28] *Coulteri*,[28] *insignis*,[29] *tuberculata*,[30] *Tæda*,[31] *rigida* [31] (*serotina* [32]), *Greggii, Teocote, patula*.[33]

* * Leaves in twos; cones with very stout prickles. *Pungentes.*

† Ducts without strengthening cells. — North America.

P. inops (*clausa* [34]), *pungens*,[35] *muricata*.[36]

†† Ducts surrounded by strengthening cells. — Southern Europe.

P. Pinaster.[37]

* * * Leaves in twos, or in the first often also in threes; cones with weak or deciduous prickles. *Mites.* — Eastern North America.

P. mitis,[38] *glabra*,[39] *Banksiana*.[40]

C. Ducts internal.

§ 8. AUSTRALES. Leaves in twos to fives; timber very heavy and resinous. — Southeastern North America, West Indies, and one species in Mexico.

* Cones subterminal; leaves in threes to fives. *Euaustrales.* [178]

P. oocarpa,[41] *occidentalis, australis*.[42]

* * Cones lateral or mostly so; leaves in twos to threes. *Elliottiæ.*

P. Elliottii,[43] *Cubensis*,[44] *Wrightii*.[45]

NOTES.

1. *P. Peuce*, Griseb., may after all be distinct from *P. excelsa;* it has much shorter leaves and sheaths, and, if my specimen can be relied on, a short fruiting peduncle; the structure of the leaf is nearly the same in both. *P. Peuce*, *excelsa*, and *monticola* have a layer of strengthening cells all around under the epidermis, interrupted only by the stomata, and not in distinct bundles as in *Lambertiana* and *Bonapartea*, while *P. Strobus*, *Ayacahuite*, and *parviflora* have scarcely any. They all have regularly two dorsal ducts only. In *P. excelsa* I have repeatedly found a third, upper, and always a parenchymatous one.

2. *P. parviflora*, Sieb. & Zucc. A branch in Herb. Haenke in the Prague Museum, marked "*P. heterophylla*, Presl, Nutka Island," seems to belong to this species, which is distinguished by slender, distantly and very slightly serrulate leaves, and scarcely any strengthening cells.

3. *P. Bonapartea*, Roezl. Prof. E. Purkinje, of the Foresters' Academy of Weiswasser, Bohemia, who was probably the first to carefully study the microscopic anatomy of the pine-leaves with a view to the diagnosis of the species, and who is now publishing the results of his investigations in an extensive and copiously illustrated work, has directed my attention to the leaf-structure of this form. It deviates from all the other *Strobi* in having numerous, usually 7 ducts, 3 on the back and 2 on each of the upper sides, and having strengthening cells in numerous bundles all around and especially in the angles. I find no stomata on the back. Roezl's *P. Don Pedri* has exactly the same structure, but has 3 or 4 series of stomata on the back; both evidently belong together. Though I have not been able to study the flowers and fruit, I do not hesitate to pronounce it distinct from *P. Ayacahuite*, which, like *P. Strobus*, has scarcely any strengthening cells, and only 2 dorsal ducts.

4. *P. Cembra*, Linn. The ducts, generally in the middle of the parenchyma, sometimes nearly approach the epidermis, but I have always found them separated from it by at least one layer of parenchymatous cells.

5. *P. monophylla*, Torr. & Frem. The number of ducts is excessively variable; I have found from 3 to 14 in different leaves. The leaves are usually curved, and the upper side, proved to be such by the relative position of the wood and bast cells (see p. 165), is always directed toward the branch. Sometimes two-leaved bundles occur. It is an open question whether the four species of the subsection *Cembroides* may not properly be united into one, as the difference of flowers and fruit is very slight, and that of the foliage only relative.

6. *P. Balfouriana*, Jeffrey, and *P. aristata*, Engelm., of the Colorado Rocky Mountains, are identical in [179] leaf-structure and in flowers, and must be united, though the cone of the former is elongated, often even cylindrical, the apophyses thicker and peculiarly spongy, and at maturity unarmed, while the other has an oval cone with thinner scales and awnlike prickles. In Utah and Nevada a form occurs with cones like the latter, but with short, stout, recurved prickles. Parlatore enumerates *aristata*, but does not mention *Balfouriana*.

7. *P. Khasia*, Royle, and its two allies, form a very natural little group. Leaves in this species with 2 dorsal ducts; strengthening cells very slight and only in the corners; male flowers 1 inch long, slender; involucral bracts 12 to 14, exterior half as long as the inner ones, all apparently pointed; anthers $\frac{3}{4}$ to 1 line long; crest only $\frac{1}{2}$ line wide, nearly entire.

P. insularis, Endl., has similar leaves, ducts often indistinct, strengthening cells slight in the corners and some scattered under the epidermis and also near the vessels; male flowers 1 inch long; involucral bracts about 8, outer pair more than half as long as the inner ones; anthers less than 1 line long, crest nearly entire.

P. longifolia, Roxb. Ducts few (in Wallich's specimens), or many (in Hooker and Thompson's), or none at all (Hooker's; Thuret's cult.); strengthening cells strongly developed in bundles all around leaf; bracts large, strongly fringed, deciduous; male flowers larger than in last, 1–$1\frac{1}{4}$ inches long, thicker; anthers $1\frac{1}{2}$ lines long; crest $\frac{3}{4}$ line wide, strongly fringe-denticulate; involucre not seen. The thick bundles of strengthening cells and the larger male flowers readily distinguish it from the two others.

8. *P. montana*, Duroi, is so well characterized that it is inconceivable how it could have been taken for a variety of *P. sylvestris*, unless some hybrid forms, which are said to occur, have created the difficulty. The involucral bracts are always more numerous, usually about 6, the anthers crested, the female aments subsessile, and the young cone erect; in *sylvestris* the involucral bracts rarely exceed 3, the crest of the anthers is reduced to a small ridge or a few teeth, the female ament is not longer than its peduncle and becomes recurved soon after flowering.

9. *P. resinosa*, Ait., is the only American representative of this well characterized group. The 6 involucral scales are articulated in the middle, the upper part falling off early (p. 168); ducts almost always only 2 on the upper side of the leaf.

10. *P. densiflora*, Sieb. & Zucc. Leaves with numerous ducts, mostly surrounded by strengthening cells, also some of these within the sheath; in a few instances, in Japanese as well as in cultivated specimens, the strengthening cells are almost wanting; male flowers oval, only 2 to 3 lines long, in an elongated spike; involucrum of 3 or 4 or

rarely 5 or 6 bracts of equal length ; anthers only ½ line long, or less, with a small, slightly denticulate crest. Only in Japan. Sometimes cultivated under the name of the following.

11. *P. Massoniana*, Lamb. Parlat., well distinguished from the tree thus named by Siebold and Zuccarini [180] and by Endlicher, which was named by Parlatore *P. Thunbergii* (see note 26). It is similar to the last, but has longer and more slender leaves and is a native of the warmer climate of Southern China, and is not hardy where *densiflora* and *Thunbergii* are. Ducts few or many, often with a few strengthening cells, these cells also in the corners, very few under the epidermis, rarely some with the vessels ; male flowers slender, cylindric, 6–8 lines long, in a spike, involucrum of 6 or 7 bracts, the outer pair rather shorter than the inner ones. Griffith, No. 4992, from Afghanistan, in Herb. Kew., with two ducts on the upper side of the broader leaves, may belong here, which would extend the geographical area of this species.

12. *P. Merkusii*, Jungh. & De Vriese, seems to be closely allied to the last and probably belongs here, or ought perhaps to be considered rather a two-leaved *Indica*. In the poor specimens at my disposal I could not discover any ducts ; the leaves are longer and more slender, the strengthening cells similarly disposed. The involucrum consists of 12 bracts, the outer pair not half as long as the inner ones.

13. *P. Gerardiana*, Wallich. Anther crests semi-orbicular, laciniate-dentate, seeds nearly 1 inch long.

14. *P. Halepensis*, Mill. Cones with longer or shorter peduncles, lateral and often low down on the axis, generally single, with flat or sometimes somewhat tumid scales.

15. *P. Pyrenaica*, Lapeyr., fide Parlatore, *P. Brutia*, Ten., and with other synonyms, not to be confounded with that other *P. Pyrenaica*, which is a form of *P. Laricio*. This species is so closely allied to the last that it is often considered a variety of it. But the leaves are stouter, the more numerous ducts are surrounded by strengthening cells, which are very scarce in the leaves of the other ; in both, these cells are found near the vessels ; the male flowers are twice as large ; the outer pair of involucral bracts is almost equal to the inner ones ; the cones are nearly sessile and thicker, generally several together, and often lateral and terminal on the same tree (see p. 171) ; the densely clustered cones in Tenore's typical specimen in the Botanic Garden of Naples are the result of disease.

16. *P. leiophylla*, Schiede & Deppe, has often 6 and even 7 leaves ; the ducts are very small and often wanting ; the strengthening cells, usually well developed in bundles under the epidermis, are, as well as the ducts, absent in Gregg's No. 821 from Zamora ; the sheaths are usually deciduous, but scarcely so in Hartweg's No. 441.

17. *P. filifolia*, Lindl. In a specimen cultivated in Kew Gardens the ducts are sometimes internal.

18. *P. Montezumæ*, Lamb., is, if I understand it correctly, a most variable species, the largest suit of different forms of which is preserved in the Berlin herbarium ; some forms have longer, others shorter leaves, or stouter or more slender ones, 3, 4 or 5 in a bundle ; cones long cylindrical or oval or conical ; the scales in the typical form are depressed and regularly rhomboidal, in other forms they become strongly umbonate. It is quite difficult, [181] therefore, to properly circumscribe the species ; for the present I feel obliged to unite with it even *P. Hartwegii* and a number of others already included by Parlatore. Only a closer study on the Mexican mountains will decide whether or not several well characterized species may be hidden among them. All those that I could examine have numerous and strong bundles of strengthening cells under the epidermis and also near the vessels, but none around the ducts.

19. *P. Torreyana*, Parry, has the same structure of the leaves. The name was published in the Botany of the Mexican Boundary, 1859, and is therefore older than *P. lophosperma*, Lindl. of 1860.

20. *P. Arizonica*, Engelm. in Bot. Wheeler, p. 260, has also this structure, and is thus distinguished from *P. ponderosa*, besides being five-leaved.

21. *P. Engelmanni*, Carrière, Conif. p. 356, *P. macrophylla*, Engelm. in Wisliz. Mem. p. 103, note 25, is a tree only known from Wislizenus' single specimen gathered in 1846 on the mountains of Cosiquiriachi, west of Chihuahua, where it is said to be abundant. The name was changed by Carrière because it clashed with Lindley's prior one ; this, however, is considered by Parlatore to be a form of *Montezumæ*, but which I have not been able to examine. Our plant differs from this species, by having its very stout leaves in threes and fours and very rarely in fives, in the strongly developed strengthening cells under the epidermis and also around the ducts, and in the form of the cone. Parlatore does not mention it.

22. *P. ponderosa*, Douglas, a variable and wide-spread species of Western North America, several forms of which have been described as distinct. The only one which may perhaps claim specific recognition is our var. *Jeffreyi* (*P. Jeffreyi*, Murr.), characterized by its darker more finely cleft bark, glaucous branchlets, paler foliage, and much larger cones, with rather slender sharp recurved prickles and larger seeds ; but it seems that intermediate forms unite it with the typical one. Another form which deserves notice is var. *scopulorum*, of the Rocky Mountains, with shorter and often binate leaves and smaller cones (see Engelm. in Flor. Calif. 2, p. 125).

23. *P. Canariensis*, Ch. Smith, is perhaps more nearly related to *P. Laricio* than to *ponderosa*. The articulation of the 4 involucral bracts is a curious feature which it has in common with our *P. resinosa* (see p. 168).

24. *P. Chihuahuana*, Engelm., first described from the mountains of Chihuahua, but now repeatedly found in Arizona, is well distinguished from all its relatives by its deciduous sheaths.

25. *P. Laricio*, Poir. Strengthening cells around ducts and in bundles all around leaf; the typical form has slender leaves and is tender in cultivation. Var. *Monspeliensis* or *Pyrenaica* (not to be confounded with No. 15, as the author of that species himself and many later botanists have done) has slender leaves with scarcely any strengthening cells around the leaf, and is more hardy than the species. Var. *Austriaca* or *nigra* is perfectly hardy; it has the stoutest leaves of all the forms, with abundant strengthening cells. A specimen in Herb. Kew., Birmah, Griffith 4993, may belong here, thus extending the range of the species far into Asia.

26. *P. Thunbergii*, Parlat. This is *P. Massoniana*, Sieb. & Zucc., and of many authors and many gardens, [182] but is easily distinguished by its stouter, shorter leaves with parenchymatous ducts. It seems peculiar to Japan, though cultivated in Australia, whence *P. Australasiaca*, Steud., an original specimen of which I have been able to examine in Herb. Cosson. Its parenchymatous ducts distinguish this species at once from any other Japanese pine, and place it near *P. Laricio*.

27. *P. contorta*, Dougl., is a little out of place here and evidently belongs nearer to the next group, but it has the subterminal cones of this. Like its American allies it is destitute of strengthening cells about the ducts, which character distinguishes it at once from its Old World associates, and so do the subulate points of the female scales. The low-growing narrow-leaved coast form, which is found along the Pacific from Northern California to Alaska, is the original *P. contorta*, Douglas (from the mouth of the Columbia River), and *P. Bolanderi*, Parlat. (from Mendocino, California); it is a regular seaside tree, an excellent screen against the Pacific storms and their salt spray, just as *P. Halepensis* is on the Mediterranean; its leaves are often entirely destitute of ducts. The broader-leaved mountain form is *P. Murrayana*, Murr., as Jeffrey's original specimens prove, which come from the sierras; *P. muricata*, with which Parlatore unites it, is very different and belongs to the coast region; this broad-leaved form extends to Oregon and to the Rocky Mountains. While the forms of the coast and of the Rocky Mountains have very knobby, oblique, serotinous, and persistent cones (see p. 172), those of the sierras have occasionally more regular, less tuberculated, readily opening, and deciduous cones, without being otherwise distinguishable (*C. S. Sargent*). The wood of this species is white and soft, and the tree is therefore often called white pine or spruce-pine.

28. *P. Sabiniana*, Dougl., and *P. Coulteri*, Don (*macrocarpa*, Lindl.), cannot be confounded by those that have been able to compare both growing; both have very large cones with spurred apophyses and large edible seeds, but the cones of *Sabiniana* are shorter, thicker, dark mahogany-brown; the seeds larger, 9–12 lines long, almost cylindrical, with much shorter wings; those of *P. Coulteri* are more slender, of a paler leather color, the seeds shorter, 6–8 lines long, and their wings longer. *P. Sabiniana* makes a round-topped tree with spreading branches and looser, more slender, and lighter foliage on glaucous branchlets; *P. Coulteri* is a more conical tree with rigid brown-green branches and denser, coarser, and darker foliage. The seeds of *P. Sabiniana* are or have been a most important article of subsistence for the Indians.

29. *P. insignis*, Dougl., distinguished by its fresh green foliage and closely and strongly serrulate leaves. Cones generally thick and very oblique, with the scales of the outer side large and thick, and on the inner side smaller and flat; some cones are more regular, all the scales nearly equally flat. For the synonymy I refer to Flor. Calif. 2, 127, repeating here only that the original *P. tuberculata*, Don, is founded on an unusually slender cone of this, [183] and that *P. Sinclairii*, Hook. & Arnott, is a factitious species compounded of a cone of this and a branch of *P. Montezumæ*. The old and evidently erroneously described *P. Californiana*, Lois., is probably our species, but cannot now be identified.

30. *P. tuberculata*, Gordon, Pinet. ed. 1, 211, not Don, a name at first erroneously given to a species sent by Jeffrey, is to be retained as now in general use, and because Don's original *tuberculata* is a mere form of *insignis*. *P. Californica*, Hartw., is the same. It is the smallest pine known as a tree, fruiting often when only 2 to 3 feet high, and rarely ever exceeding 15 or 18 feet. (See Engelm. in Flor. Calif. 2, 128.)

31. *P. Tæda*, Linn., and *P. rigida*, Mill., have sometimes, besides the regular parenchymatous, smaller, accessory internal ducts, thus approaching the *Australes* group. The cones are of a pale brown color, mostly very spinous, and very rarely serotinous. It is confined to the wet or sandy lower districts along the coast from Delaware to Eastern Texas. The most inland localities may be the Stone Mountain near Atlanta, Georgia, and Camden in Arkansas.

32. *P. rigida*, var. *serotina*, *P. serotina*, Michx., I cannot distinguish specifically from *rigida*; it is more apt to grow on wet places (whence the name *Pond-pine*) and has longer leaves (occasionally, on strong shoots, in fours), and the cones often do remain closed for several years, as is also sometimes found in the northern *P. rigida*. The typical subglobose form of the cones which Michaux figures in his Sylva is quite peculiar, but only found in the coast

region of South Carolina, from whence Dr. Mellichamp sends them ; further inland the cones are more elongated, often twice as long as in the northern *rigida* (Wm. H. Ravenel, Aiken, S. C.). Prof. Sargent observed it on the Georgia and East Florida coast, but not in West Florida or in Alabama. Felled trees or posts set in the ground sometimes make sprouts bearing primary leaves.

33. *P. patula*, Schiede & Deppe. The epidermis cells of the leaves protrude so that the surface appears minutely tuberculate.

34. *P. inops*, var. *clausa*, was discovered and named by Dr. Chapman at Appalachicola, Florida, and Prof. Sargent finds it quite common on Cedar Keys. It is distinguished from the species by decidedly narrower leaves and by its cones being often serotinous, more in one tree than in another. The leaves are $\frac{1}{2}$ line wide, while in the species they are often $\frac{3}{4}$ and even nearly 1 line wide ; the sheaths in both forms are at last deciduous; young branches green, in the northern form glaucous ; involucrum of 10 to 11, in *inops* of 8 to 9 bracts ; cones larger, mostly subsessile, recurved ; in the other, mostly longer peduncled and patulous ; cotyledons fewer, 4 or rarely 5, in the other 5 or 6.

35. *P. pungens*, Michx. Leaves rarely in threes and sometimes with accessory internal ducts. The cones persist sometimes 20 years or longer.

36. *P. muricata*, Don. Male flowers only $\frac{1}{2}$ inch long in a spike of about 1 inch in length, similar to those of *tuberculata* and *insignis ;* antheral crest strongly denticulate, in the others nearly entire. Specimens have [184] been collected at Tomales Point with subterminal cones, not different in any other respect. The cones of the southern specimens (from Monterey, etc.) have usually very long, $\frac{1}{2}$ inch, and stout curved spurs, especially on the outer side, and fully deserve their specific name, but others from farther north (Mendocino, etc.) are more regular, with short and thin, though very sharp, prickles.

37. *P. Pinaster*, Ait. The male flowers form a large oval head ; involucral bracts often only 3 or sometimes 4, all of equal length. Geographically and structurally this species is more nearly allied with *P. Canariensis*, less so with *Laricio*, but is distinguished from both by the lateral (quite rarely subterminal) female ament.

38. *P. mitis*, Michx. Wide-spread through the middle and partly the southern States, rare in New Jersey and not now found farther north ; westward to Arkansas and to Missouri south of the Missouri river, where it is the only species of pine ; it is found always on silicious soil ; it furnishes excellent " hard pine " lumber. The outer pair of the 9–12 involucral bracts is scarcely half as long as the inner ones.

39. *P. glabra*, Walt. Similar to the last, with slender foliage, smoother bark (in young trees and on the branches the grayish bark is quite smooth) and almost unarmed cones, distinguished by Walter 100 years ago, but long overlooked, until W. H. Ravenel, about 25 years since, rediscovered it. Dr. Mellichamp finds it scattered on the coast of South Carolina, where it grows on the edge of or in swamps, and on the knolls in them, with *Magnolia*, *Fagus*, and *Nyssa ;* rarely on sandy soil, and never in the so-called Pine-barrens. He describes the branching of the tree as singularly characteristic, the spray usually being flattened somewhat like that of Cedrus. It probably extends through the lower parts of the southeastern and southern States, as it is again found in Mississippi (E. Hilgard). The tree (known in South Carolina as the *Spruce-Pine*) grows up to 80 feet in height ; the gray bark of such old trees is flaky, and is compared by some to that of the sugar-maple, by others to a smoothish white-oak bark. The leaves are usually $2\frac{1}{2}$ to 3 inches long, not half as thick as they are wide, while in *P. mitis* their thickness exceeds half their width ; the external involucral bracts are minute.

40. *P. Banksiana*, Lamb., published 1803 in Lambert's first edition, a year prior to Poiret's name of *P. rupestris*, which name, erroneously preferred by Parlatore, must give way to the former. Probably the only pine with erect or at least patulous cones ; the small prickles of the very young cones soon disappear, so that the mature ones are unarmed. The base of the wing entirely covers the outer side of the seed and separates from it, just as it does in *Picea*, and which I have not seen in any other pine to this extent. The cones are often serotinous and persist for a long time. The seeds seem to germinate most readily, just like those of *P. Tæda*, and in moist sandy soil, in old fields, and along railroads young trees spring up abundantly. It makes a moderate-sized tree, but is perhaps never over 20 or 30 feet high, and 10–12 or very rarely 18 inches in diameter. Very common in Northern Michigan and Wisconsin, it does [185] not seem to extend farther westward than the Saskatchewan, where it is replaced by *P. contorta*.

41. *P. oocarpa*, Schiede. Most of the ducts are internal ; occasionally a parenchymatous one was found in the leaves examined by me. Further investigation must show whether this species may not more properly be referred to its Mexican neighbors of the *Pseudostrobi* group. Strengthening cells are abundant around, under the epidermis and also near the vessels.

42. *P. australis*, Michx. Male flowers $2\frac{1}{2}$–3 inches long, the longest of any pine, of rose-purple color ; lowest pair of involucral bracts minute. On a very vigorous shoot I have seen the female ament lateral (see p. 170), a rare anomaly. In the germinating plantlet, the long wing remaining attached to the seed shell is raised up like a flag by the growing cotyledonous leaves.

43. *P. Elliottii,* Engelm. For a full account see below.

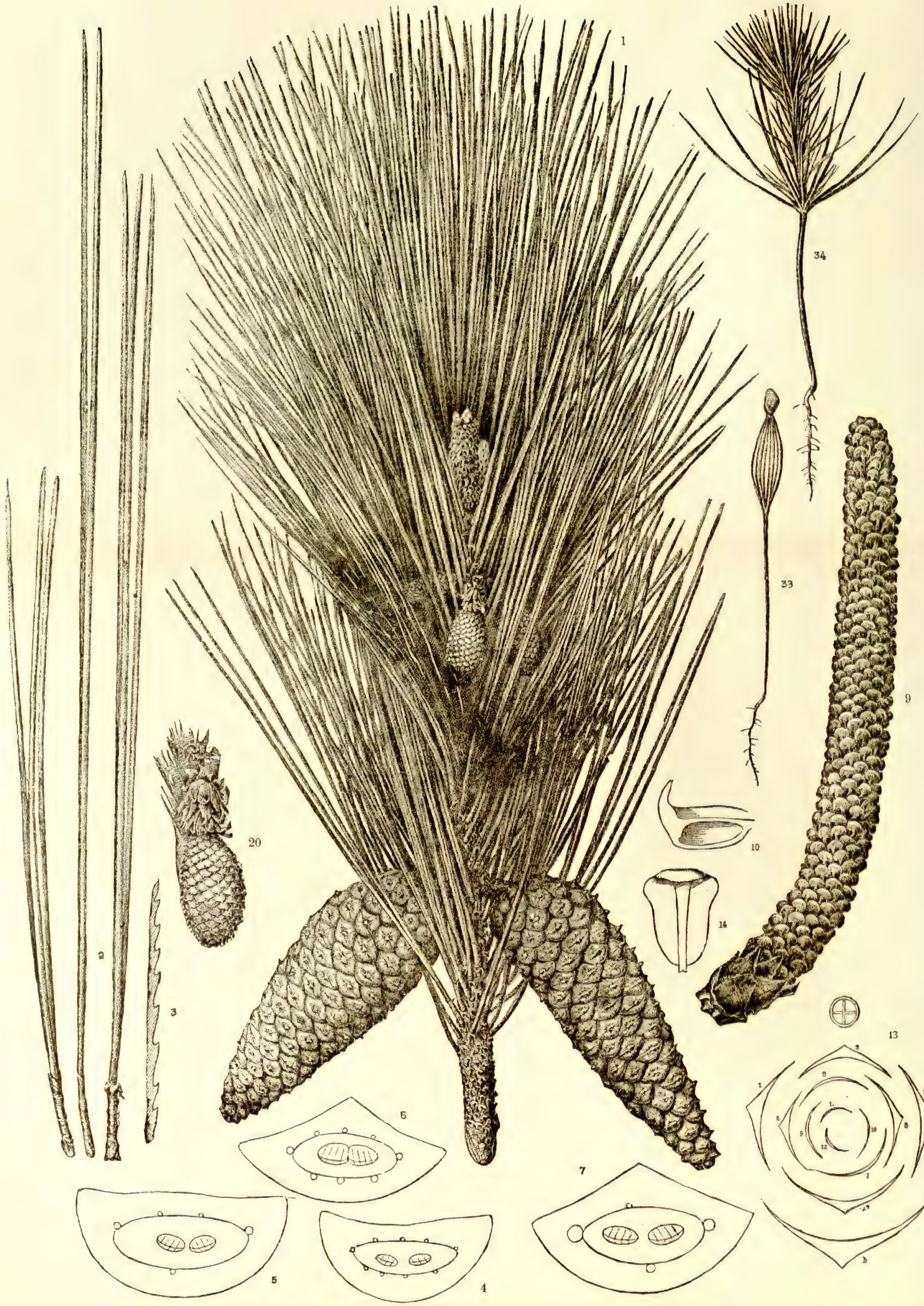
44. *P. Cubensis,* Griseb. Leaves in threes, only exceptionally in twos, 8–10 inches long, rarely longer, stout, about ¾ line wide, rigid, strengthening cells largely developed under the epidermis (so that their bundles sometimes extend from the epidermis to the ducts) and also near the vessels; bracts 3-3½ lines long, strongly fringed, reflexed, rather persistent; male flowers about 1½ inches long; involucral bracts 13-15, the outer pair half as long as the inner ones; anther-crests scarcely denticulate; cones 2½–3 inches long, short-peduncled, scales depressed; seeds 3½ lines long, faintly ridged; wing nearly twice as long, widest at base, tapering to an acutish point. The var. *terthocarpa*, Wright, in Gris. Cat. Cub. 217, is a very curious form but not a variety. It seems that in this case the growth of the axis is entirely arrested after producing an ament, and does not even elongate in the following season; the maturing cone, therefore, remains erect near the top of the branch. I have seen an analogous arrest of growth in the biennially-maturing *Quercus chrysolepis.* It is found in different parts of Cuba, in the maritime districts as well as on the mountains, and is probably the same that gives the name to the Isle of Pines. A cone from the Bahama Islands, preserved in the Kew Museum under the name of *P. Tæda,* probably also belongs here.

45. *P. Wrightii,* Engelm. n. sp. Leaves in twos, very rarely in threes, slender, 5 to 8 inches long, ½ line or less wide; sheaths 4 lines long, with age a little shorter; bracts small (1½ lines long), very slightly fringed and rather deciduous; cones lateral, peduncled, recurved, oval, 1½ to 2½ inches long, scales radiately grooved, thickened on the crenulated edge, apophyses retused, umbo immersed, prickles short; seeds 2½ lines long, faintly ridged, wings (perhaps incomplete?) not much longer, widest above the base. — Mountains in Eastern Cuba, apparently mixed with the last, Chs. Wright, No. 1462 in part, 3190. Distinguished from the allied *P. Cubensis* by its slender binate leaves, short scarcely fringed deciduous bracts and smaller cones and seeds. I have not seen the male flowers. The cone-scales of both species are arranged in the $\frac{21}{34}$ order, the 8 and 13 spirals being the most prominent.

PINUS ELLIOTTII, Engelm. n. sp.

A large tree, 50–100, rarely to 110 feet high, 2–4 feet in diameter, with (7–15 lines [186] thick) laminated, reddish-brown bark; leaves in twos and threes, in the axils of lanceolate, long-fringed, somewhat persistent bracts, 7 to 12 (mostly about 9) inches long, ¾ to nearly 1 line wide, rigid, closely serrulate, acutish; sheaths at first about ¾ inch long, later withering to one-half that length; resin-ducts internal (adjacent to the sheath of the vascular bundles). Male flowers from the axils of similar, persistent bracts, cylindrical, elongated (1½ to 2 inches long), in a short head (not more than 1 inch long), each one surrounded by an involucre, 4 lines in length, of about 12 bracts, the exterior pair strongly keeled, half the length of the inner ones; anthers with semicircular, denticulate, rose-purple crests; pollen grains 0.037 to 0.045, on an average 0.04 lines in the longer diameter. Female aments peduncled, mostly 2 to 4, or rarely to 6 together, oval, purplish, at first erect, but soon assuming a horizontal and (a month later, and before the leaves are well developed) a recurved position, the axis meanwhile elongating and in vigorous trees not rarely forming a second tier of aments several inches above the first ones; the bracts above the aments bear the usual leaf-bundles, so that no naked space is left; carpellary scales broad, rounded, more or less abruptly cuspidate, their bracts half their length, transverse, retuse. Cones peduncled, recurved, oval to cylindrico-conical, 3 to 6½, usually 4 to 5 inches long, 1¾ to 2¼ inches in diameter (when closed), of a rich brown color and almost glossy; bracts thickened, retuse, or emarginate; scales in $\frac{13}{21}$ order, the 5 and 8 spirals most conspicuous; larger scales 2 inches long and 7 lines wide; apophyses marked with grooves, radiating from the slightly prominent umbo, transversely divided by a sharp ridge, armed with a short stout or rarely a slender sharp prickle. Seeds triangular, 2½ to 3½ lines long, dark, slightly ridged, and rough on the under side; wing 4 or 5 times as long (13 to 16 lines long), somewhat oblique, obtuse, with nearly parallel sides, or usually somewhat broader below, its base covering the greater part of the outer or upper surface of the seed; cotyledons 6 to 9, usually 8. — *P. Tæda,* var. *heterophylla,* Elliott, Sketch, 2, p. 636.

Common, in light sandy damp soil, among the sandhills near the sea-beach and along the marshes near the mouths of rivers; also found in damp clayey pine lands and with [187]



Pinus Elliottii. Plate I.

P. rigida, var. *serotina*, in pine-barren ponds, rarely exclusively covering small tracts, and only as a second growth in old fields. From South Carolina, on the sea islands near Charleston, to Georgia along the coast, and sparingly as far as 15 to 20 miles inland, but never very far from the influence of salt-water, *Dr. Mellichamp;* to Georgia, *Elliott;* and Florida, *Canby, Curtiss;* forming forests on the St. John's River, where it is often called *Slush-pine*, and is not cut for timber, *Sargent;* "the most common pine in South Florida, the 'short-straw pine' of the wood-cutters, taller, more slender, and with harder wood than the 'long-straw pine,' *P. australis*, which is the principal forest tree of Eastern, Middle, and Northern Florida," *Dr. A. P. Garber;* extending westward to Alabama, "a common tree along the bay of Mobile," *Mohr, Sargent.* Prof. Sargent observes that while the long-leaf pine rapidly disappears under the axe, Elliott's pine becomes more and more common, the young second-growth forests in Florida almost entirely consisting of this species and of *Tæda.*

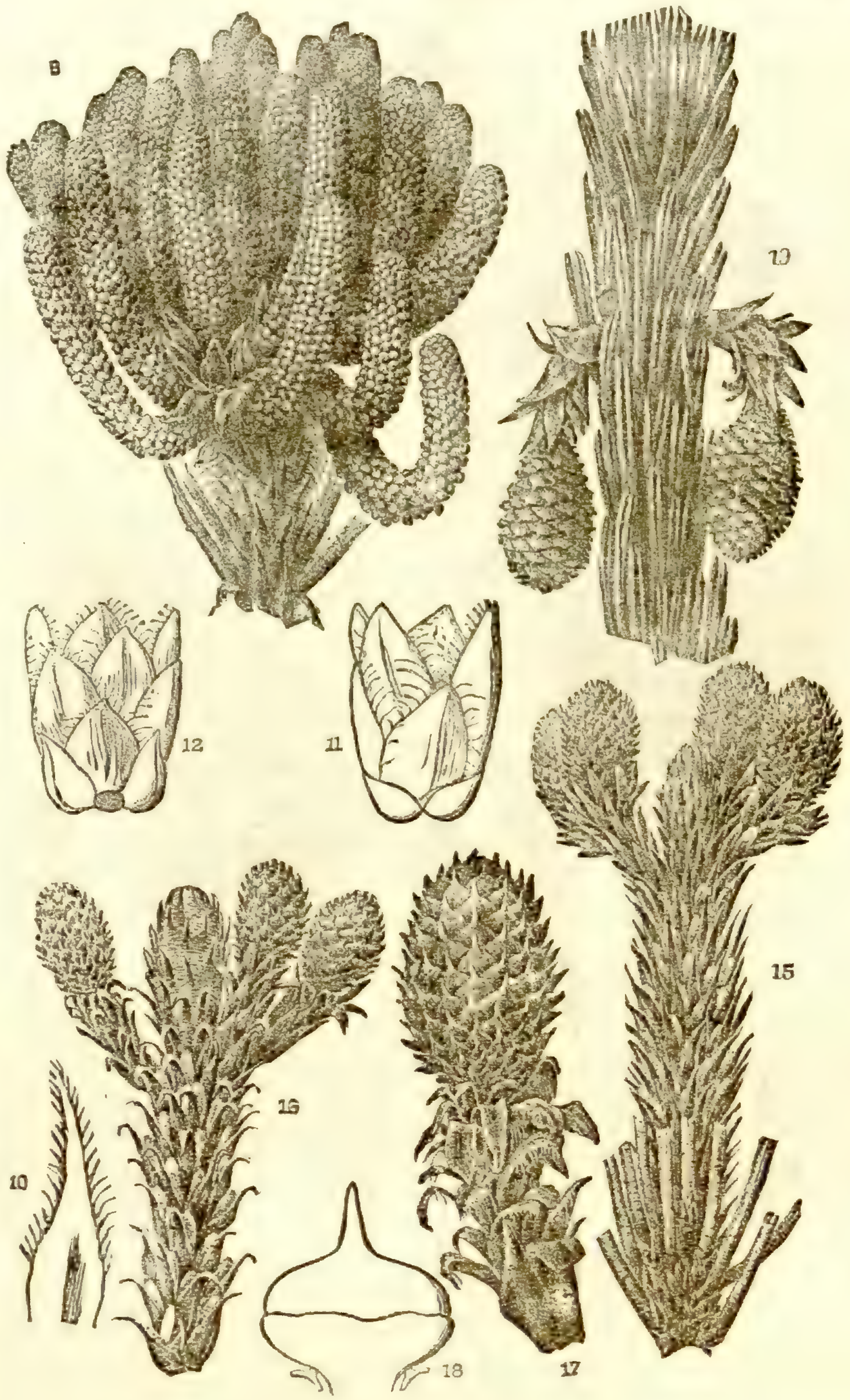
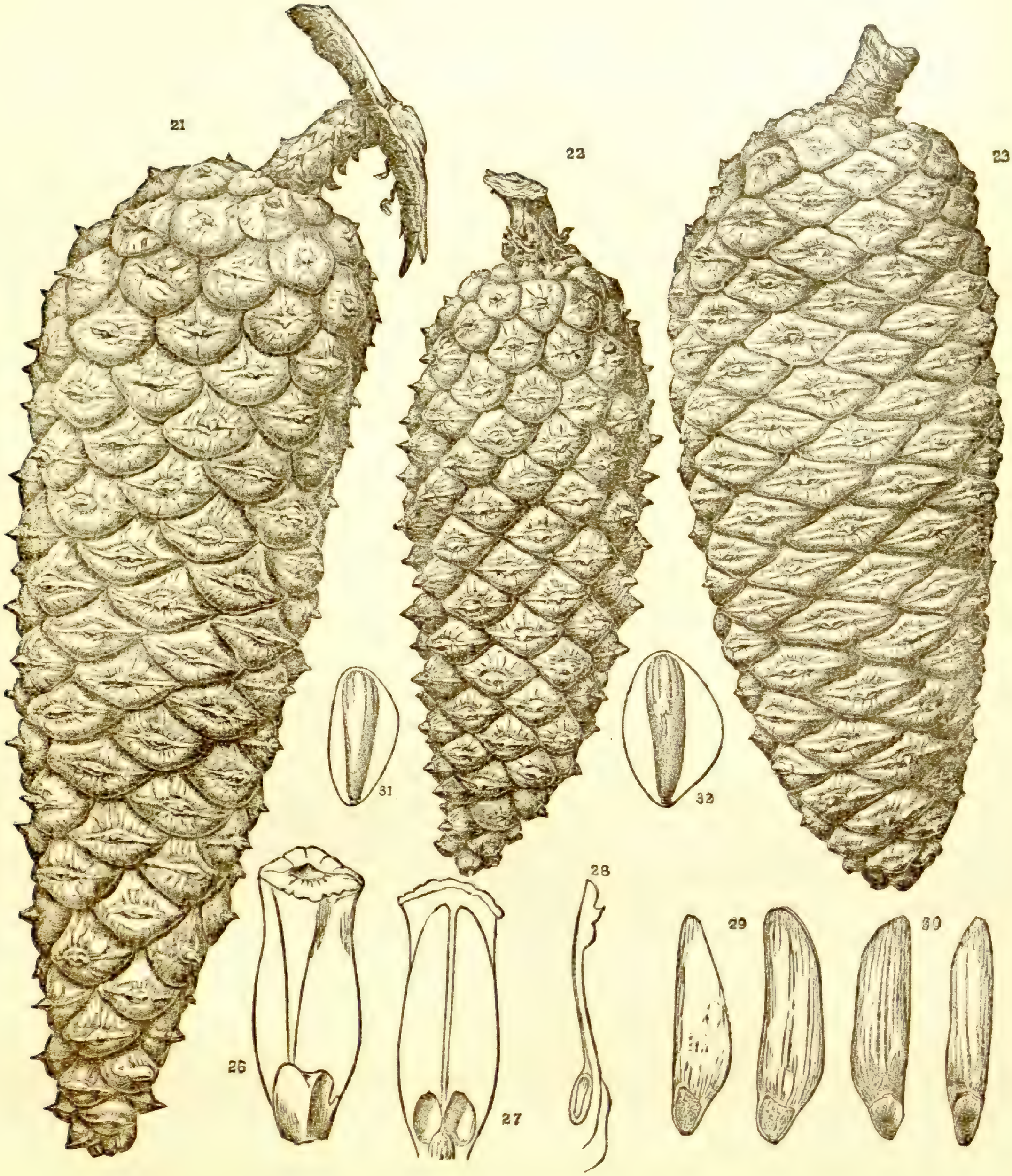
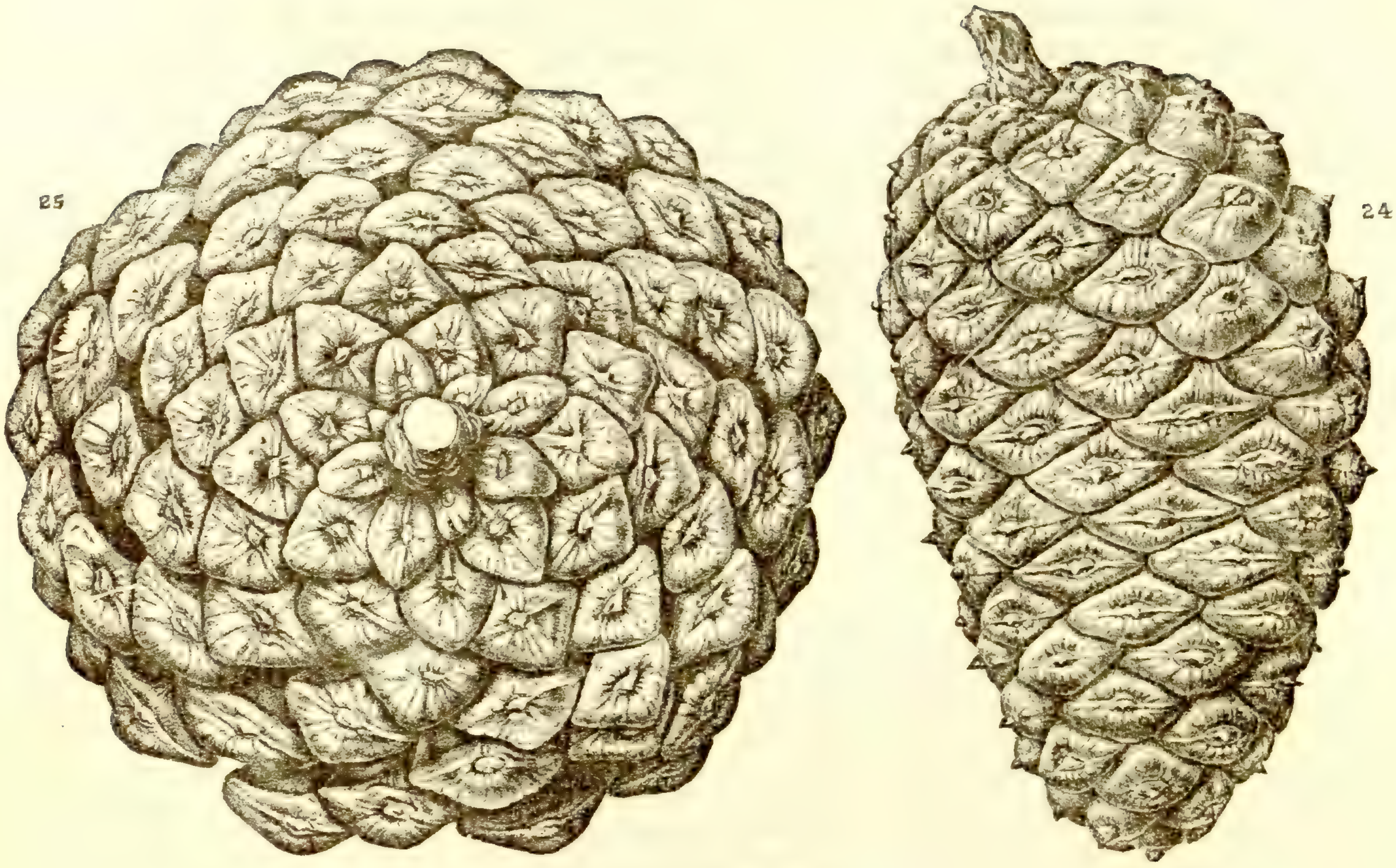


PLATE II.

This is the earliest flowering pine of those regions, from 2 to 4 weeks in advance of any other pine, showing its rose-purple male flower-buds already in December, and in January or February, according to latitude and season, shedding its abundant pollen, which, wafted by the winds, is apt to cover roads and streets, and especially sheets and pools of water, far and wide, with its sulphur-looking powder. *P. australis*, also with rose-purple flowers, comes several weeks later, and then the others, — *P. Tæda*, next *P. glabra* and *mitis*, and lastly *P. rigida*, var. *serotina* with greenish-yellow



Part of Plate III.



PART OF PLATE III.

flowers. Our species bears abundantly every year (at least in South Carolina), different from *P. australis*, which, like many other pines, is fruitful only every other season. The cones also mature and drop off earlier than those of the associated pines, and shed an abundance of seeds, which readily germinate about November, and develop their young stems in spring.

This tree Prof. Sargent considers by far the handsomest of all the southern pines, readily distinguished from those with which it is associated, by its heavier, denser heads, darker foliage, and larger and heavier branches.

The red-brown bark is very characteristic of this species; it is regularly laminated, and [188] the outer laminæ exfoliate in rather rigid and brittle, often very thin, plates of a purplish color when fresh, whence the local name of *Blue Pine;* the bark of *P. australis* is somewhat similar, but the plates are much larger.

The timber is excellent, heavy, very tough, and more resinous even than that of *P. australis*, which it resembles; of a striped yellowish-brown and paler resin color (the inner portion of each ring, formed earlier in the season, being paler; the outer part, of later growth, brown); fibre coarser than in *australis* and more tenacious. It grows rapidly, at least in its youth: a tree of 22 inches diameter, and about 140 years old, had in the semi-diameter 8½ inches of heartwood with 74 annual rings, and white sapwood 2½ inches thick with 60 to 70 rings; another of over 3 feet diameter, 109 feet high, and 200 years old, had a radius of 17 inches heartwood with about 140 rings, and 3 inches of sapwood of 60 rings. Thus the average rings of the heartwood were over 1⅓ lines and those of the sapwood (because of later growth) about ½ line wide. The leaves of young trees are more frequently in twos, in older ones as often in threes; those of trees from swampy soil are apt to be shorter than others; the structure in all of them is the same.

Our species is closely allied to *P. Cubensis* (see p. 185), and further study of the latter may possibly prove them to be nothing but geographical varieties. Meanwhile the constantly three-leaved foliage, the larger number of involucral bracts of the smaller male flowers, the smaller cones with smaller, shorter-winged seeds, distinguish *P. Cubensis* from our species. Of the bark, of the timber, or of the behavior of the young cones in this species we know nothing.

P. Elliottii was imperfectly known to Elliott, and was considered by him a form of *P. Tæda*. Later botanists ignored it till Dr. J. H. Mellichamp of Bluffton, S. Car., rediscovered it about ten years ago and directed my attention to it. Without his diligent investigations, ample information, and copious specimens, this paper could not have been written. At the same time I gratefully acknowledge my obligations to many botanical friends in this country and in Europe, and especially to the directors of the botanical gardens and the curators or possessors of the great [189] herbaria, who most liberally furnished me with the material to carry on my investigations of the Pines and of the Conifers in general. I am particularly indebted to Messrs. Bolander, Brewer, Parry, and Lemmon for their contributions of the Californian and Rocky Mountain Conifers, and to Messrs. Canby, Gilman, Ravenel, and Mellichamp for those of the northern and eastern American Pines.

EXPLANATION OF FIGURES.

Plate I. Fig. 1. A branch, gathered in September, showing two mature cones, of the preceding years, flowering, and three young ones of the spring. One-half nat. size.

Fig. 2. Leaves in twos and threes. Nat. size.

Fig. 3. Their close serratures. Magn. 60 times.

Figs. 4-7. Sections of leaves magnified 30 times; 4 and 5 of binate, 6 and 7 of ternate leaves; the ducts are seen closely appressed to the sheath which encloses the vascular bundles; these bundles are, as in most pines, double, and either separate or closely approximate and almost united; the ducts are wide or small, few or many, in these specimens, varying from 4 to 9.

Plate II. Fig. 8. Male inflorescence, capitate, with the elongated flowers in the axils of fringed bracts.

Plate I. Fig. 9. One of the flowers, magn. 3 times, exhibiting the calycoid involucrum.

Plate II. Fig. 10. A bract, and

Fig. 11. The involucrum from the dorsal, and fig. 12 from the ventral side, exhibiting the lowest lateral pair of bracts and the succeeding inner and upper ones. Magn. 4 times.

Plate I. Fig. 13. Diagram of the involucrum with the supporting bract; the 2 outer scales are strongly, the 4 next ones slightly, keeled.

Figs. 14 and 10 bis. Effete anther from above and the side, showing the transverse erect crest and one of the longitudinally opened cells. Magn. 10 times.

Plate II. Fig. 15. Female aments in bloom, the axis above them already elongating.

Fig. 16. The same, a little more advanced.

Fig. 17. An ament magnified twice.

Fig. 18. A female flower (carpel scale) in the axil of the broad retuse bract — only the upper, cuspidate half being visible, and below the bifid tips of the (rather clumsily executed) ovules — in February. Magn. 10 times.

Fig. 19. Female aments, six weeks or two months later, recurved.

Plate I. Fig. 20. One of these, magnified.

Plate III. Figs. 21-24. Closed cones of different sizes and shapes, showing their variability.

Fig. 25. Base of an open cone with spreading scales.

Figs. 26, 27, 28. Scales of a cone. Fig. 26, dorsal view, showing the bract and the apophysis; fig. 27, view from above, exhibiting the impression made by the seed and the surface from which the wing had become detached; fig. 28, section of a scale with the seed (exhibiting the embryo) and wing.

Fig. 29. Seeds from the lower, and, fig. 30, from the upper side, with differently shaped wings; in fig. 29, the rough under surface of the seed is seen; fig. 30 shows its upper surface partly denuded of the wing-covering.

Figs. 31 and 32. Albumen and embryo of different shapes. Magn. 4 times.

Plate I. Fig. 33. A germinating seed in November. [190]

Fig. 34. A seedling of the following spring, exhibiting the 8 cotyledons, the primary leaves, and upward already some pairs of secondary leaves.

The plates were drawn on stone, from nature, by Mr. Paulus Roetter, late of St. Louis, who had made himself so favorably known, more than twenty years ago, by the beautiful Cactus plates published in the Report of the Mexican Boundary Commission, and who has since greatly added to his fame and his usefulness by his artistic work in the Zoölogical Institute in Cambridge.

X. COLLECTED DESCRIPTIONS OF CONIFERÆ.

From the Gardeners' Chronicle.

Abies Menziesii and A. Engelmanni. — There seems to be a confusion in regard to them. In Colorado [790] they occupy different altitudes, — *Menziesii* the lower elevations, wet places, bogs, banks of mountain streams up to 8,500 feet altitude. Hence, up to the timber line *A. Engelmanni* is found, often forming large forests, or mixed with *A. lasiocarpa* (the *Abies grandis* of the Colorado botanists), *Pinus contorta, flexilis,* and *aristata. A. Menziesii* has a gray rough bark, which reminds one of an Oak, *A. Engelmanni* a thin scaly cinnamon-brown bark. The leaves of the former are certainly very stiff, and, at least in Colorado, spinous, pointed, and often flattened; those of *Engelmanni* much softer, thinner on lower, thicker and shorter on higher altitudes. Both extend north-west to Oregon and British Columbia, and there forms of *Menziesii* occur with obtuse leaves. In cultivation the *A. Menziesii* from the north-western sea-coast undoubtedly behaves very differently from that the seeds of which were obtained in the Rocky Mountains. The same difference, I suppose, exists between other Conifers common to both regions, *e. g., A. Douglasii, P. contorta* and *ponderosa.* Now as to the light glaucous, or rather light blue variety of *Menziesii,* M. André justly extolled, and very appropriately named it after Dr. Parry, who first introduced it. In several gardens at Cambridge, Mass., and the neighborhood, fine young specimens can be seen, well grown, of regular but very stiff outlines, in which even the rigidity of the leaves is detected by the eye, without the aid of the touch. Larger ones make a striking impression on the stranger in the lawns and yards about residences at Denver (Colorado); but he looks in vain for the same in the mountains. The fact is, that the old tree is mostly irregular and ugly, and has a green foliage; only the young branches of the spring, and still more the young sprouts, showing the peculiar whitish blue color, and many trees show scarcely any such tints. To be beautiful and striking it must be young. It is well known that the same color variety is found in many other Conifers. A striking example is *Abies concolor;* the young plants raised from the seeds I brought in 1874 from Glen Eyre, at the base of Pike's Peak, are whiter than that of *Menziesii,* while others show this peculiarity much less. I may as well add the remark that *Abies concolor,* heretofore considered a most rare tree of New Mexico, proves to be common from Southern Colorado, through New Mexico, Utah, and Arizona, and throughout the Californian sierras. I have scarcely a doubt that the so-called *Abies grandis, Abies Lowiana,* and *Abies lasiocarpa* (not the Oregon plant of Hooker, *Fl. Bor. Am.*) of these mountain ranges, are nothing but forms of this same *A. concolor.* — [June 23, 1877, n. s., vol. vii.]

Portland, Oregon, Aug. 6, 1880.

Abies amabilis. — In an expedition to explore the forests of the Pacific coast regions we, Prof. C. S. Sargent, [720] Dr. C. C. Parry, and myself, three weeks ago ascended Silver Mountain, near Fort Hope, Frazer River, and found there, at an altitude of 4,000 to 5,500 feet a fir which we recognized as the long doubted *Abies amabilis,* growing with *Tsuga Mertensiana, T. Pattoniana, Pinus albicaulis,* and *P. monticola,* and rather higher than *Pseudo-Tsuga Douglasii.*

A few days ago Prof. Sargent undertook the ascent of the very mountain just south of the Cascades of the Columbia, where Douglas fifty-five years ago discovered *A. amabilis* and *A. nobilis,* and found on that classical ground, not only these two trees, but also *T. Pattoniana* and *monticola,* some *P. contorta* and a few feeble *Abies grandis.* The *amabilis* is there better developed than further north, and we had photographs taken of specimens, copies of which I send to you.

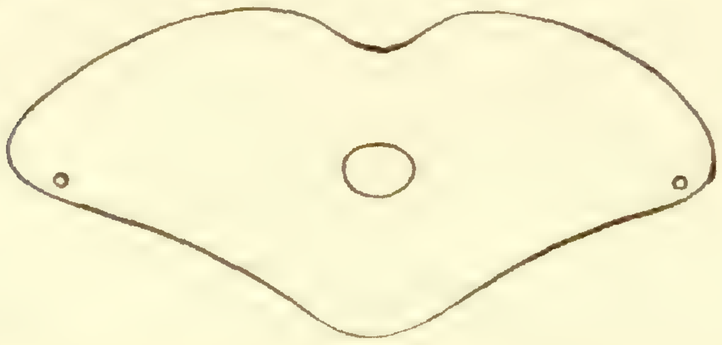


Fig. 136. — Abies amabilis: Diagram of Section of Leaf showing the Position of the Resin-Canals.

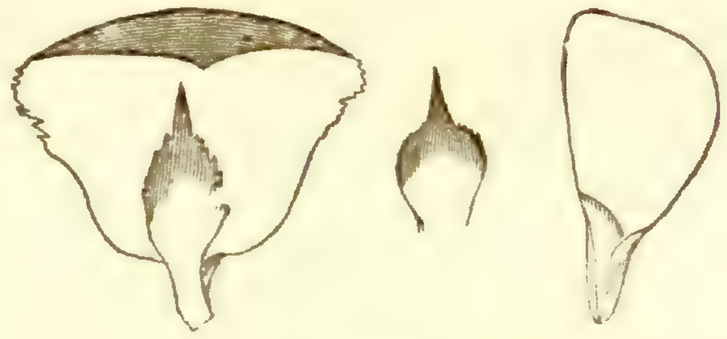


Fig. 137. — Abies amabilis: Bract, Scale, and Seed.

It is a magnificent tree, at about 4,000 feet altitude; the largest specimen, growing on the banks of a mountain torrent, was probably 150 to 200 feet high, with a trunk about 4 feet in diameter, branching to the ground and forming a perfect cone of dark green foliage. The bark of the old tree is 1½ to 2 inches thick, furrowed and reddish gray, that of younger trees, less than 100 years old, is quite thin and smooth, light gray or almost white. It certainly is very closely allied to *A. grandis,* but is readily distinguished by its very crowded darker green foliage (whence the name

which I had given it in my Synopsis of the American Firs, taking it then for a form of *A. grandis*, viz., var. *densifolia*, was well applied), and its large dark purple cones. The technical characters are the following : —

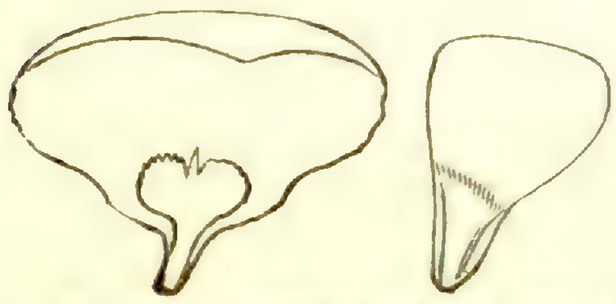


Fig. 138. — Abies grandis : Scale, Bract, and Seed.

Leaves densely crowded, dark green, channelled, and without stomata above, keeled, and with two white bands below, slightly notched on the lateral and sterile branches, acute on the leaders and on the cone-bearing branches, (these acute leaves often with a few stomata on the upper side toward the tip,) resin-ducts close to the epidermis of the lower side (fig. 139).

Cones (fig. 141) deep purple, 4 and sometimes 5 inches long, 2 to 2¼ inches in diameter, slightly tapering to a retuse tip ; scales in ⅔¼ order, not much broader than high, their bracts often more than half as long as the scale obovate, abruptly acuminate, deep purple upward (fig. 137).

Wings of seeds obliquely cuneate, as long as wide, or longer (Fig. 137).

A. grandis (which is common on the low lands along the rivers in Oregon, Washington Territory, and the southern parts of British Columbia, and abnormally ascends) has lighter colored leaves, usually longer, and always less crowded (distichous, with 2–4 ranks of shorter leaves on the upper side of the branchlets), also without stomata above, more deeply emarginate on the branches, obtuse or very shortly cuspidate on the fertile branchlets, acute or acuminate only on the leaders ; cones 3–4 inches long, 1½ inches or scarcely more, in diameter, apple-green, and usually less resinous ; scales much broader than high, their bracts about one-third the length of the scale, obcordate or retuse mucronate, light green ; wings of seeds hatchet shaped, wider than long (fig. 138).

A. amabilis has the purple cones and sharp-pointed leaves (on fertile branches) of *A. subalpina*, but this latter has not such crowded leaves, much smaller cones, and is especially distinguished by the parenchymatous resin-ducts. *A. subalpina*, common in the Rocky Mountains, has been found also in Oregon (probably only east of the Cascades) and northward, but we have not as yet met with it here.

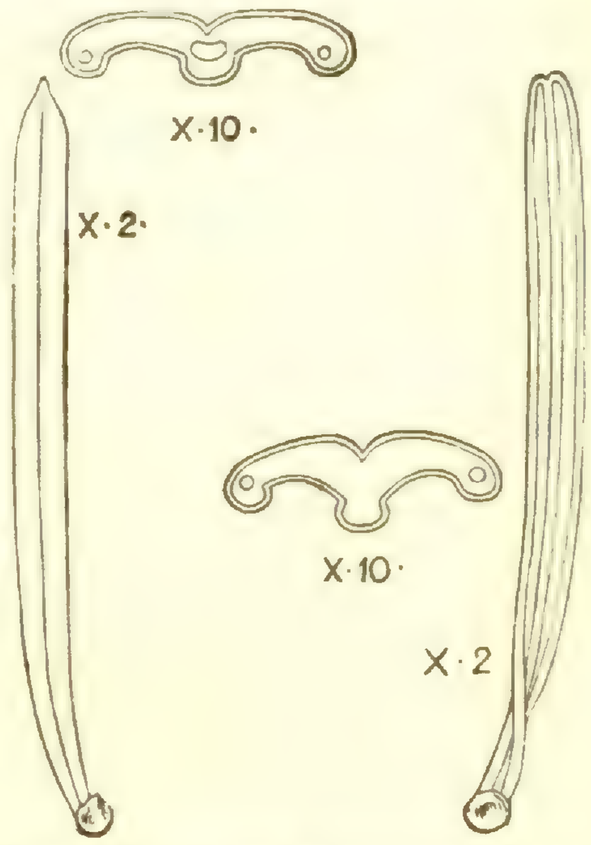


Fig. 139. — Abies amabilis : Leaf from Sterile and from Fertile Branch, with Sections.

We send you a photograph of a cone-bearing branch, and, slightly smaller than natural, one of a sterile branch of an old tree (fig. 140) ; * on the latter you will see the crowded arrangement of the leaves ; on the former the shape of the cone, and the sharp-pointed leaves at its bases (fig. 141). It will thus appear that Lambert's figure of the cone-scale and bract of his *Abies grandis*, though a little exaggerated, is in the main correct, especially as to the long, abruptly acuminate bract, the figure of which has given rise to the confusion with the Californian *A. magnifica*. — [Dec. 4, 1880, n. s., vol. xiv.]

Picea Engelmanni and Picea pungens. — In the *Gardeners' Chronicle* of December 24, 1881, p. 828, I [145] notice a reference to the beautiful blue spruce of the Rocky Mountains, under the name of *Picea Engelmanni*. This is a mistake, which I have repeatedly met with. The spruce in question is my *Picea pungens*, formerly (but erroneously) referred to *P. Menziesii* (=*P. Sitchensis*), of the Pacific coast. The true *P. Engelmanni* is a second distinct species of the same mountain region, but occupying higher elevations. It forms extensive forests at an altitude of from 9,000 to 11,500 feet up to the timber line, and a scrub above it. It has pubescent reddish branchlets, square leaves less sharply pointed, and small cones ; its light cinnamon-brown bark is thin and scaly, and the leaves of young seedlings are smooth-edged. *Picea pungens* has white glabrous branchlets, stouter, in old specimens somewhat flattened, spiny-pointed leaves, blue in young trees and in the young growth of old trees ; the cones are much longer and paler, the bark thick, cracked, and grayish ; leaves of seedlings somewhat denticulate. It never occurs in forests, but is scattered along the banks of mountain streams at lower elevations than the other. Old trees become bare and quite unsightly, but the large pale cones in their tops are a very conspicuous feature. — [Jan. 4, 1882, n. s., vol. xvii.]

Tsuga Pattoniana and Hookeriana. — Perhaps you will permit me to venture a suggestion in reference to two other West American Conifers which have occasioned a good deal of doubt, discussion, and hypothesis, — I mean *Abies*, or properly *Tsuga*, *Pattoniana*, and *Hookeriana*, which are also mentioned in the same page of the *Gardeners' Chronicle*. Prof. Sargent and myself have visited Jeffrey's localities of Scott's Mountain, in North California (not Oregon) and the mountains south of Fort Hope, on Frazer River in British Columbia, connected with the Mount Baker Range. In both localities (as in many others near the timber line in Oregon and California) the beautiful Tsuga now known every-

* The large figures 140 and 141 from these photographs have of necessity been omitted. — Eds.

where as *Pattoniana*, but in Edinburgh called *Hookeriana* — that with the angular leaves — abounds, with larger or smaller purple, or sometimes green cones. On the northern mountains only, and not in California, and where the Edinburgh *A. Pattoniana* with flat leaves is said to come from, *Tsuga Mertensiana* climbs up to the same altitude as the other, — smaller there, but otherwise undistinguishable from the seaside form. Now the leaf anatomy of the tree in the Edinburgh Botanical Garden, raised from Jeffrey's seeds, and cultivated there as *Abies Pattoniana*, is that of a true Tsuga, and cannot be distinguished from that of *T. Mertensiana*, as the figure of Prof. McNab in Proc. Roy. Irish Acad., vol. ii., pl. 23, fig. 2, under the name of *Pinus Pattoniana*, shows, and as I have myself found it in examining the Edinburgh specimen; but the original figure in the so-called Oregon Committee's Report is that of the angular-leaved tree called there *A. Pattoniana*, and now generally known by this name, or sometimes as *A. Williamsoni*. Now, is not the flat-leaved tree called in Edinburgh *A. Pattoniana*, the mountain form of *Tsuga Mertensiana?* This I suggest as a plain solution of the difficulty. The only objection seems to lie in the reported size of the cones of this species, which are said to be nearly of the size of what we now call *Pattoniana*, and much larger than those of *Mertensiana*; but may there not be some error or confusion about these cones? At all events, I cannot distinguish the Edinburgh *A. Pattoniana* from *T. Mertensiana*, nor the small mountain form from the colossal seaside trees of this species, and I find no third species. — [Jan. 4 1882, n. s., vol. xvii.]

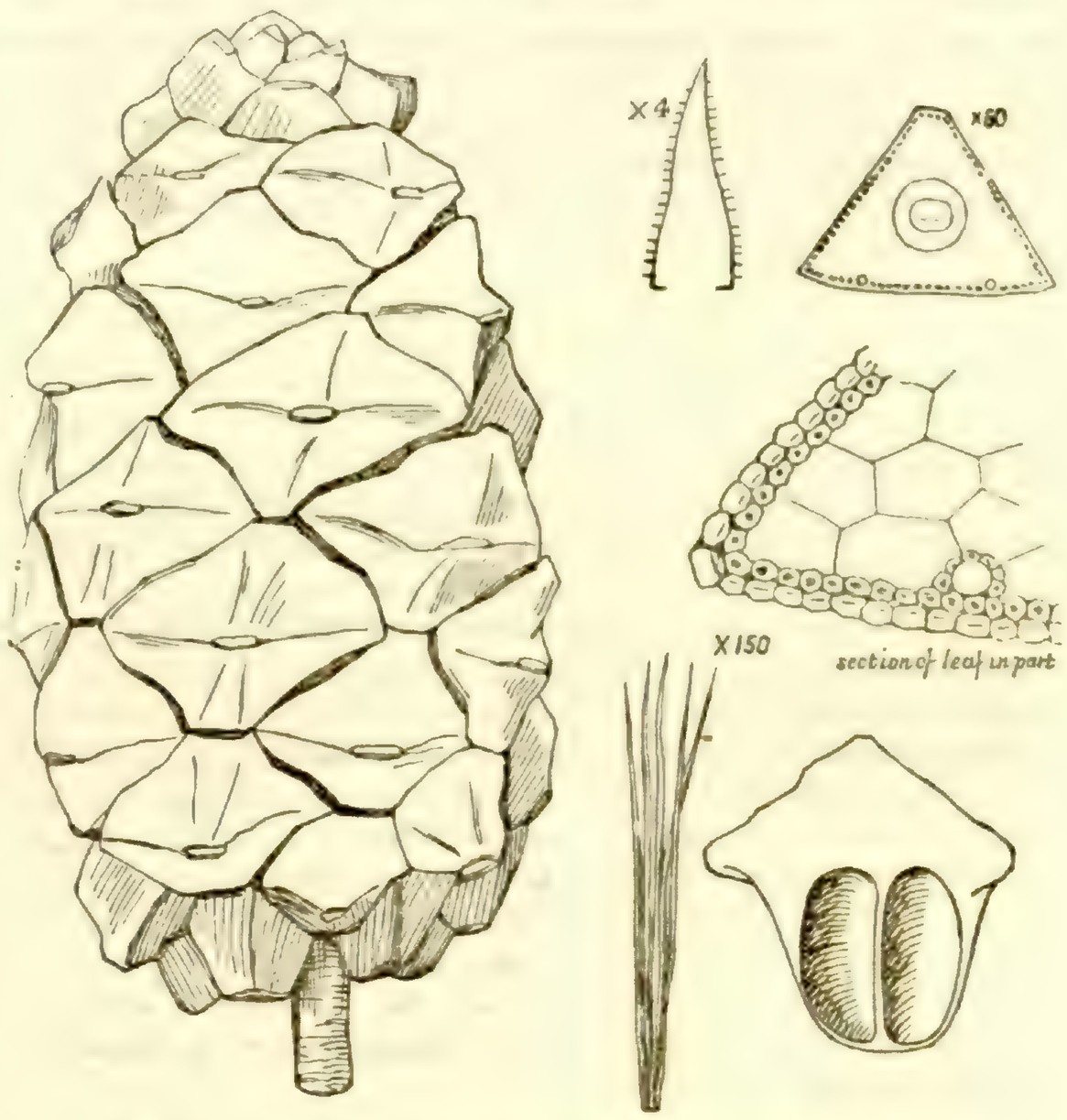


FIG. 125. — PINUS LATISQUAMA: CONES, LEAVES, AND FRUIT-SCALES ACTUAL SIZE; LEAF-SECTIONS MAGNIFIED.

PINUS LATISQUAMA, *n. sp.*, I name [712] an interesting new pine, discovered by Dr. E. Palmer in 1880, in the mountains south of Saltillo, Mexico. It belongs to the Pinasters with peripheral ducts in the leaves and with subterminal cones. The short (1½ to 2 inches long) extremely slender and slightly serrulate leaves are in fives; their lanceolate, almost entire bracts, and their loose sheaths are quite deciduous; the ovate subcylindrical cones, 3 inches or more long, are peduncled and subterminal, *i. e.* they are produced above the uppermost leaves of the season, and between them and the terminal bud or the shoot of the following season; their chestnut-brown, shining scales are obliquely rhomboid, very broad, transversely carinate, with the umbo depressed and without a prickle; the lowest scales of the cone have the form of reflexed tubercles; the seeds apparently large and wingless (fig. 125, p. 713).

This species, about the habit, bark, and timber of which nothing further is known, has very peculiar alliances. The foliage and its sheaths, and the position and the peduncle of the cone, would make it a Strobus, if the form of the cone-scales did not constitute it undeniably a Pinaster; it is evidently most nearly allied to the cembroid or Nut-Pines, but recedes from them by the leaves being serrulate and the cone-scales being without those bosses which are so prominent in the true Nut-Pines. The leaves are among the thinnest pine-leaves known, scarcely one-third line wide; they have two very small peripheral ducts on the dorsal side, separated from the epidermis only by the simple layer of hypoderm cells which underlie the epidermis all around the leaf. The cone here figured (fig. 125), was 3½ inches long, and 1¾ inches in diameter when closed, its peduncle ½ inch long. The scales were arranged in $\frac{13}{21}$ order: the middle ones are unusually wide for the size of the cone, 1 inch or more broad. Seeds were not seen, but the cavity of the scale shows that they are probably ½ inch long or over, and destitute of a wing. — [Dec. 2, 1882, n. s. vol. xviii.]

PINUS CONTORTA. — The figure of *Pinus contorta* at p. 45 most probably represents the broad-leaved *P.* [351] *Murrayana*, which is a large tree with tall trunk 3 feet in diameter in the sierras, 1–1½ foot in the Rocky Mountains; but young trees will, of course, remain bushy, clothed with branches to the base. The wood is soft and white, like spruce wood more than any other pine wood I know; and if there is any specific character in the wood structure

it must be distinct from the true *P. contorta* of the coast, which has heavy, resinous, hard wood, like *P. sylvestris;* but I confess that, with the exception of the breadth of the leaves, I find no other botanical characters to distinguish the two. Well grown cones of *Murrayana* are nearly symmetrical, others are more or less oblique, like those of true *contorta.* — [Mar. 17, 1883.]

From "A New Fir of the Rocky Mountains," by Lester F. Ward.

Abies subalpina, *Eng. n. sp.* Tall and slim, 80 to 100 feet high, often 50 feet without branches; bark [555] smooth, white, and covered with vesicles to near the base; leaves 6 to 12 lines long, less than a line broad, not twisted near the base, bisulcate and somewhat glaucous on the lower (outer) side, short-pointed, obtuse or slightly emarginate, those on the lower branches 2-ranked and spreading, those on the upper scattered, crowded, and more or less appressed, shorter on fertile than on sterile branchlets; cones $2\frac{1}{2}$ to 3 inches long, $1\frac{1}{2}$ to 2 inches thick, solitary, erect, ovate or oblong, obtuse, greenish; scales 6 to 10 lines long and about as broad, horizontal and close-pressed, broad-cuneate, unguiculate; the rounded upper margin somewhat reflexed and resinous, pubescent; bracts short, white with a dark base, erose-dentate all round, their slightly elevated summits furnished with a strong mucro; seeds large, the wing covering nearly the whole surface of the scale; sterile aments 2 inches long, 3 lines in diameter, marked longitudinally and somewhat spirally by the dark centres of the otherwise light brown mucronate scales. — *American Naturalist,* 1876, vol. x.

From the Botanical Gazette.

Tsuga Caroliniana, *n. sp.* A small tree of the southern Alleghany Mountains with larger (6–8 lines [223] long, $\frac{3}{4}$–1 line wide), darker leaves than the common hemlock spruce, retuse or often notched at tip, without stomata above, beneath with two pale bands, each with 7 or 8 series of stomata; strengthening cells under the epidermis on keel, midrib, and edges; cones 12–14 lines long, scales oblong, much longer than wide, in $\frac{8}{13}$ order, spreading at right angles after maturity, broad bracts slightly and obtusely cuspidate; seeds (2 lines long) with numerous (15–20) small oil vesicles on the under side, twice shorter than wing.

Mountains of North and South Carolina, on dry slopes and ridges. — Smaller, stouter branched than *T. Canadensis,* from which it is always readily distinguished by its larger cones with wide-spreading scales. It was first noticed in the mountains of South Carolina by Prof. L. R. Gibbes of Charleston in 1850, who sent specimens to Prof. A. Gray in 1856, and in an accompanying letter suggested for it the name of *Pinus laxa;* he obtained it from both Caro- [224] linas. Prof. Gray himself had already collected it in 1842 on Bluff Mountain, N. C., in foliage only; and last year Mr. A. H. Curtiss again met with it "on Pinnacle Mountain, N. C., a long ridge commencing about 8 miles south of Hendersonville, probably 3,000–4,000 feet high, where in groups of only few trees it occupies slopes near the summit, and even cliffs, while *T. Canadensis* abounds in the ravines of the same region; both species are cultivated side by side at the entrance of Mr. Middleton's place at Flat Rock, 3 miles from Hendersonville, where their branches interlock and their differences are strongly exhibited." I have not seen any young shoots of this species, and therefore cannot say whether their leaves are spinulose-denticulate, as they are in young plants of the two other North American species. These may be distinguished thus: —

T. Canadensis: leaves of the mature tree smaller (4–7 lines long), obtuse with 5 or 6 series of stomata on each side of the keel below, destitute of any strengthening cells; scales of cone in $\frac{5}{8}$ order, orbicular-oblong with broad truncate bracts; wing very broad at base, tapering, scarcely longer than the seed which shows 2–3 large oil vesicles.

T. Mertensiana has larger leaves, with two bands each of 7–9 series of stomata; strengthening cells few on the edges and very sparse on upper and lower side of leaf; cones 6–12 lines long (not $1\frac{1}{2}$ inches, as sometimes stated), scales oblong, mostly a little narrowed in the middle, bracts slightly cuspidate; seeds smaller with few oil vesicles, wings twice as long as the body of the seed. — 1881, vol. vi.

A few remarks by Engelmann on *Abies Fraseri* and *A. balsamea,* entitled "Notes on the Coniferæ," will be found in the proceedings of the Philadelphia Academy for Sept. 19, 1876, pp. 173–175, and in "Gardener's Monthly," 1877, vol. xix., p. 308. Their substance is contained in the descriptions of these species above. — Eds.

XI. NOTES ON WESTERN CONIFERS.*

From the Botanical Gazette. Vol. VII. 1882.

In another publication I intend to give a full account of the observations on *Coniferæ* made in the Pacific [4] States, when with Prof. Sargent and Dr. Parry I explored their forests, but it seems proper that I should not withhold any longer the principal results arrived at.

Abies amabilis, (Douglas) Forbes, is not a variety of *A. grandis*, as I had assumed, but a very distinct species peculiar to the higher mountains of the Cascade Range from Oregon to British Columbia. It is easily recognized by its dense, dark-green, glossy leaves, very white underneath, usually emarginate, but on the fertile branchlets acute; by its large very thick purple cones and oblanceolate acuminate bracts.

Abies nobilis, (Douglas) Lindley, is peculiar to the higher mountains of Oregon and has not yet been found in California nor, as far as I can learn, in Washington Territory. Its grooved leaves crowded on the branchlets, and its large purple cones with long exsert recurved bracts, well characterize it. The tree on Mount Shasta which has gone by this name (also in the Flora of California) is distinguished by its quadrangular leaves, keeled on the upper side; its large cones considerably resemble those of *nobilis* and have often, not always, exsert and recurved bracts; it is a form of *A. magnifica*, Murr., the common Red Fir of the Californian sierras, which has bracts normally enclosed.

Pinus reflexa, n. sp. (*P. flexilis*, var. *reflexa*, Eng. in Rothrock's Rep. Bot. Exp. Wheeler), proves to be quite distinct from *flexilis*, not only by the reflexed scales of the cone, but also and principally by the long peduncled cylindric female aments, erect in the first, recurved in the second year, which associate it with the true *Strobi*, while the large wingless seeds distinguish it from the other species of that section.

P. albicaulis, Eng., is specifically distinguished from *P. flexilis* by its subglobose purple cones with short, thick scales, and its thin white at last scaly bark.

P. Chihuahuana, Eng., observed by us in the Arizona Mountains, proves to be of peculiar interest as maturing its cones in the third year, the only American species with this character, which I have found only once more in the Mediterranean *P. Pinea*.

P. Jeffreyi, Murr., holds its characters well wherever we have seen it from the mountains west of Mount Shasta, where it was first discovered, down to the San Bernardino Mountains, affecting more particularly the eastern slopes. The glaucous branchlets with pleasantly aromatic fragrance, thinner glaucous foliage, the great size of the cones with thin, spiny recurved mucro on the scales, large seeds and more numerous cotyledons, distinguish it from *P. ponderosa*, which has brownish-green branchlets with a turpentine odor and dark green coarser foliage.

P. Arizonica, Eng., has also been repeatedly collected by us as well as by subsequent explorers, and the question has been agitated whether it may not be also a form of *P. ponderosa*. The fact is that five-leaved forms of this species do occur on the Californian sierras (Lemmon) and on the Arizona Mountains (Lemmon, Pringle), but the [5] larger number of leaves is here a casual occurrence; the branchlets show the brown-green color noticed above, the leaves are dark green and have the structure described by me in Wheeler's Report. *P. Arizonica* has glaucous branchlets, thinner leaves, constantly in fives, and of different structure; its cones are thicker and shorter with much more prominent umbos, but not much weight can be put on this last character.

XII. MISCELLANEOUS PAPERS ON CONIFERÆ.

MORPHOLOGY OF THE CARPELLARY SCALES OF CONIFERÆ.

The true nature of the female flower of *Coniferæ* has been an important question among botanists since fifty [469] years, when Robert Brown first announced the doctrine of their gymnospermous character. Without going into details of the history of investigations and theories, it may be stated at once that the very thorough treatment of the question by G. Stenzel, published a few months ago in the Nov. Act. Nat. Cur., vol. xxxviii., as reported by Professor Eichler

* Reprinted in the *Gardeners' Chronicle*, n. s., vol. xvii., Feb. 25, 1882, p. 260. In this connection mention should be made of a lecture by Dr. Engelmann at Washington University, reported in the *St. Louis Daily Democrat* of March 6, 1875, under the heading The Forests of the Rocky Mountains, and reprinted in the *Gardeners' Monthly* for May–July of the same year (pp. 151–153, 181–184, 214–217), under the title The Coniferæ of the Rocky Mountains. This and a note on Conifers from Colorado, based on the observations of Engelmann, printed in the *Gardeners' Chronicle*, n. s., vol. iii. March 27, 1875, p. 402, and the *Gardeners' Monthly*, June, 1875, pp. 213–214, possess more popular than scientific interest, and are omitted from this volume. — Eds.

in Flora of September 1, seems definitely to settle the controversy. The results of Stenzel's examination of numerous monstrosities of female flowers of the *Abies excelsa*, obtained at the limit of tree-vegetation on the Sudetic Mountains, is that Mohl's view of the structure of the fruit-scale, based on the nature of the double leaf of *Sciadopitys*, is the correct one. The fruit-scale in *Abies*, and in all *Abietineæ*, in this view consists of two leaves of an undeveloped axis, or branchlet originating in the axil of the bract, and the posterior (superior) edges of these leaves being connate laterally and a little backward, as the lowest pair of leaves or bracts in *Coniferæ* always are, the leaves turn their back toward the axis of the inflorescence (the cone), and bear on that side one ovule each. In *Cupressineæ*, where the carpellary scale is peltate, and often bears numerous ovules, the same morphological explanation holds good, and even in *Podocarpeæ* and *Taxineæ*, which have no fruit-scale, we must come to the same conclusion, assuming a [470] virtual suppression of the scale. The greatest difficulty seems to arise from the position of the ovules on the dorsal side of the open carpel, which is not seen in any angiospermous plants ; however, the anther-cells, which morphologically correspond to the ovules, are in *Coniferæ* also borne on the lower side of the stamen-scale ; and for further analogy we have to look to the *Cycadeæ*, and, be it boldly announced, to the Ferns. *Lycopodiaceæ*, on the other hand, bearing the spore-cases on the upper side of the leaf, cannot be regarded as the progenitors of *Coniferæ*, as has been thought. The relationship of *Coniferæ* is with *Cycadeæ* and Ferns, while *Gnetaceæ* becomes still farther removed from them. The writer of this notice has seen monstrous (proliferous) cones of *Abies Engelmanni*, in Colorado, but only at the upper limit of tree-vegetation, under similar conditions to the European monstrosities. He has also noticed the foliaceous development of the carpellary scales, in monstrosities of *Abies Canadensis*, either into a distinct or a more or less connate pair of leaves ; but only at the base, not, as in other species, at the top of the cone. — *Amer. Journ. Sci. and Arts*, 3d Series, vol. xii.

THE GYMNOSPERMY OF CONIFERÆ.*

Celakovsky, who takes a high position as a morphological botanist, mentions that in the year 1874 he pub- [311] lished in Flora an article opposing gymnospermy. He now announces that he has changed his opinion, having satisfied himself of the truth of this doctrine. The agent of conversion was a monstrosity of the Norway Spruce cone, like that from which Stenzel made out the now accepted morphology of the cone, and the same monstrosity as that which Braun studied in the Larch, deducing from it the accepted doctrine many years ago. The essential point in this monstrosity is that the bracts of the abnormal catkin develop into leaves, and the carpellary scale before it into a pair of leaves transverse to the bract. The abietinous carpel consists of these two leaves united by their posterior edges (i. e., those next the axis of the cone) into a scale, the back of which therefore faces the axis of the cone, and bears the ovules. The lower part of these catkins is usually normal, the apex by prolification is gradually transformed in the manner here specified, and becomes a leafy branch. Dr. Engelmann, in this Journal, three years ago, gave a confirmatory account of an analogous monstrosity in the Hemlock Spruce, but in which the transformation was at the base of the cone, the lower bracts leaf-like and with a pair of leaves in their axil, the following bracts more and more scale-like ; the geminate leaves in their axil were partially united, next forming a scale with a cleft or notched apex, then an entire carpellary scale, in the axil of a normal bract.

Celakovsky, having now seen the Spruce monstrosity for himself, adopts the inevitable conclusion, and applies it well to the settling of the question of gymnospermy. He declares that the dorsal origin of the ovule of the *Abietineæ* proves that it is no axillary production, and thus the main support of those who take the ovule for a simplified female flower falls to the ground. Moreover, the ovules of *Coniferæ* in retrograde metamorphosis never change into shoots, but simply disappear. If flowers, they would be expected sometimes to become foliaceous branchlets. So Celakovsky regards it as demonstrated that they are outgrowths from the dorsal face of the leaf, analogous to the sori and indusia of Ferns. He cites the indusium of *Hymenophyllum* as an instructive analogue, only it is marginal ; that of *Davallia* is somewhat dorsal ; that of *Cyathea* wholly so and yet cup-shaped. He goes on to say that the gymnospermy of *Abietineæ* being thus proved, that of the rest of *Coniferæ* follows of course ; that Braun has seen similar pro- [312] lification in the catkins of *Taxodineæ*, in which the carpel-scale was replaced by a bud ; that, although the carpel-scale in *Abietineæ* consists of two leaves, the bud may in other cases develop more than two leaves, so that the lobed scale of *Cryptomeria* may be composed of as many leaves as there are lobes. Moreover, although the ovules in *Abietineæ* originate from the scale, the greater part of the scale is developed after the formation of the ovules ; and in *Cupressus* the scale is developed even as late as the following spring, while the ovules are produced in the autumn. However the case may be disguised, Celakovsky asserts his firm conviction, 1st, that an ovule can only be developed as depending on a carpel, and, 2d, that its nucleus represents the macrosporangium of vascular cryptogams. He adds that this is the logical consequence of the theory of descent, and must be true if the doctrine of the genetic connection of the vegetable world is true. He considers that Van Tieghem and Strasburger have proved the seemingly simple scale of *Cupressineæ* and *Taxodineæ* to be composed of bract and carpel-scale united (which indeed is evident in *Tax-*

* Review by Engelmann and Gray of a paper by Dr. L. Celakovsky, in Flora for June, 1879, Nos. 17 and 18.

odineæ), and that Braun has confirmed this by the study of proliferous cones. As to the development of ovules earlier than the carpels they belong to, this is said to have been observed in some Angiosperms also, as in *Cuscuta*, in which at first four naked ovules appear. The anatomical organogenist may argue from this that ovules and carpels are independent productions, but Celakovsky insists that he will argue wrongly.

This brings our author to the consideration of the structure of *Taxineæ*. This is environed with difficulties, and explanation is only conjectural. Here the disc, arillus, cupula, or whatever it be called, makes its appearance where no trace of carpellary scale is to be seen. Celakovsky inclines to the view that this organ, occurring in whatever form, is most probably the carpellary scale itself, very tardily developed. In *Dacrydium* the cupule is homologous with that of *Taxus*, but oblique. *Cephalotaxus* has no scale and no cupule, but seems to correspond with *Cupressineæ*, and shows at maturity a small flattened rudiment between the two ovules, which is probably a rudimental carpel-scale. *Ginkgo* is the most puzzling; yet it seems probable that the biovuliferous peduncle represents the abietinous carpel-scale, the peduncle itself being its elongated base. The cupule of *Taxus* may be either a simple circular carpel, or may consist of more than one carpel. The apparently terminal ovule of *Taxus* and *Torreya* he would regard as axillary to one of the uppermost subtending bract-scales; for he will not concede that the ovule can be wholly destitute of a carpellary organ. Yet he might do so, in one sense; for if the carpel may develop very late and very imperfectly or very little, it may sometimes not visibly appear at all, and so the phyllome be reduced to the ovular outgrowth.

Finally Celakovsky notes, that if the ovule of *Taxus* and *Torreya* be axillary to an uppermost scale, it would originate not from the dorsal but from the ventral face, i. e. from the upper side of the leaf; which [313] would distinguish *Taxineæ* from all true *Coniferæ* — a view which would not be destitute of important support. For both Braun and Mohl have seen apparently androgynous scales in some *Abietineæ*. In a monstrous Larch-ament, among carpellary scales with normally dorsal ovules Braun found one with ovules on the opposite face; and Mohl describes and figures an androgynous inflorescence of White Spruce, with pollen-sacs on the outer face, and on the other a pair of knobs which from their form and position might be taken for imperfectly developed ovules. But this latter case seems most ambiguous. If it was in a male catkin, the upper part of which had become female by the development of carpel-scales in the axil of stamens partially transformed into bracts (which is the case we have before us in a monstrosity of Hemlock Spruce), then the quasi-androgynous scale in question may have been the normal abietinous carpel-scale itself, with the polliniferous bract behind it and connate with it.

The androgynous spike of Hemlock Spruce before us is below normally staminate; above some anthers are slightly scarious-winged at one side of the projecting tip, another has this wing developed into a bract-like body on the whole of one side; next there is a bract with a single small pollen-sac on one side of its back, and in its axil a well-formed and biovulate carpel-scale. — *Amer. Journ. Sci. and Arts*, 3d Series, vol. xviii., Oct. 1879.

ON THE FEMALE FLOWERS OF THE CONIFERÆ.

Under this heading Professor Eichler of Berlin gives his latest views about this important subject in the Monatsberichte der K. Acad. der Wiss., Berlin, 1881. He takes it for granted that the morphologists of the present [419] day are agreed that the male *flowers* are the aggregate of stamens which were formerly (and still by Parlatore in DeC. Prodromus) considered an ament, i. e. an inflorescence. He now tries to prove that what we call the female ament is perfectly conformed and corresponding in every respect to the male flower in position as well as in structure, and thus is also a single flower and not an inflorescence.

The simplicity of such an arrangement, the uniformity in the structure of the male and female organs thus established, are certainly seductive, and in the author's opinion the difficulties in his way are readily enough removed. The principal difficulty is found in the presence of two foliaceous organs in the female flower, one, now called the ovule-bearing or carpellary scale, inside of another, the bract, while the male flower consists of a number of simple pollen-bearing bracts (the stamens) arranged around the axis. Now, according to Professor Eichler's view, the carpellary scale is not a distinct organ, but really only an appendage, a ventral excrescence, a ligule, if it may be called so, of a leaf (the bract), born from it and belonging to it; he therefore recognizes only one organ, the bract, and the so-called carpellary scale as its appendage, — a view already indicated by Sachs. He reviews and controverts the views of preceding morphologists. Robert Brown declared the carpellary scale to be a leaf in the axil of the bract; but this is a morphological impossibility. Schleiden and Strasburger took it for a flattened axis; but the arrangement of the bundles of vessels makes that untenable. Van Tieghem thought it was a leaf median on an undeveloped axillary bud, but *Coniferæ* never do produce such median leaves. A. Braun, and after him Caspary, were the first to recognize in the scale a compound organ, consisting of two lateral leaves of such an undeveloped bud, connate on their lower side; Oersted, and more decidedly Mohl, showed that these two leaves were connate with their posterior edges, turning their backs toward the main axis, and Mohl happily compared the scale thus constituted with the double leaf of *Sciadopitys*; this, however, seems impossible to Professor Eichler, because nothing is *seen* of such an assumed undeveloped axillary bud, and because the distribution of the vessels in the scale does not indicate a double origin, as it does distinctly in the *Sciadopitys* leaf.

Professor Eichler insists that the carpellary scale of *Coniferæ*, though often apparently separated from the bract, is really not a distinct organ, but, as stated above, a ligular appendage of the upper face of the bract. He shows that in such appendages the vascular bundles are always arranged in a system opposite to that of the leaf from which they originate; if they spring from the upper side of the leaf, this upper side is turned toward the upper side of the leaf, and if they come from the dorsal side, their dorsal side is turned toward the back of the leaf, and in either case the arrangement of the vascular elements is reversed. In every leaf the xylem (wood-cells) occupies the upper or [420] ventral side of the vascular bundle, and the phloëm (formerly bast or soft bast-cells) lies below it or toward the dorsal side of the leaf. This is so in the coniferous leaf as in all others, and in the bract, while the ligule or carpellary scale shows the arrangement reversed, — a well-established fact. This carpellary scale wherever it exists (principally in *Abietineæ*) bears on its back one or several ovules. In *Araucaria* it is a small process, of ligular form, from the middle of the leaf-bract, with one ovule ; in *Cunninghamia* it is a narrow transverse crest with three ovules ; in *Cryptomeria* it is a jagged crest, at last much larger than the bract itself ; but in *Damara* no trace of an appendage can be found. The same is the case with most *Taxodineæ*, where only a certain thickening of the bract is noticeable. But in *Abietineæ* we see two apparently distinct organs ; examining them, however, more closely, we find them always cohering at base, and where they at maturity separate from the axis as in *Abies* and *Cedrus*, they fall off together, as they should do, where one is only an appendage of the other. In *Cupressineæ* no carpel-bearing appendage at all is observed, and the ovules are as nearly axillary as possible, or, where there are many, they seem to spring partly from the base of the bract and partly from the axis itself ; but the thickened upper side of the scale shows also a reversed arrangement of the vessels, "as it cannot be otherwise, where the leaf is so thickened on the inner side that at last it even becomes peltate." The other *Coniferæ* follow the same rule, the ovules stand in the axil of the bract ; but in *Taxineæ* they are terminal products, surrounded by the uppermost leaves or bracts.

The proliferation sometimes observed in the female flowers of *Abietineæ* has been thought to furnish proof for the axillary nature and distinctness of the carpel ; but Professor Eichler is satisfied that the abnormally developed branchlet is not the development of a supposed carpellary axis, but a really new axillary production of the bract therefore between the carpellary appendage and the main axis, and that the division of the carpel into two pieces, often noticed in such monstrosities, is produced by pressure only.

Eichler then compare the ovule of the *Coniferæ* to the sporangium of allied vascular cryptogams, and finds in *Isoetes* the sporangium on the base of the leaf where also a ligula is present, in *Lycopodium* in the axils, and in *Psilotum*, at the end of branchlets. The essential character of gymnospermy, however, he finds not as much in the open carpel which also occurs in some higher organized plants, as in the absence of a stigma and in the immediate action of the pollen on the ovule.

In a second paper, "Ueber Bildungsabweichungen bei Fichtenzapfen" (Sitzungsb. d. K. Ac. Wiss., Berlin, 1882), Professor Eichler gives us a careful analysis of monstrosities observed on the Norway Spruce, and of one on the Himalaya Hemlock, and tries to show how former interpreters had misunderstood their teaching, and how these examples fully confirm his own views, expressed in the foregoing paper. He has procured the very specimens [421] which Stenzel, Willkomm, Oersted, and Parlatore had examined, analyzed them with great care, and gives figures and sections of the principal forms found. He demonstrates that the so-called fruit-scale in those monstrous cones is not divided into two lateral leaves, but becomes irregularly toothed, folded or lobed, sometimes simulating two or more leaves, and finally develops a knob and at last a bud, which may and does sometimes grow out into a branch, always on the inside of and adnate to the metamorphosed scale, i. e. on the side toward the axis of the cone, often enveloped by its folds, but never between it and the bract, which ought to be the case if the now prevailing view of the nature of the scale (as formed by two lateral leaves connate on their axial side) were true.

Unfortunately he has not had occasion to examine such monstrosities where these two leaves are foliaceous, partly or entirely distinct, originating not from the base but from the very axil of the bract, and not divided by any possible pressure, such as occur at the base, not at the top, of proliferous cones of *Tsuga Canadensis*. In such cones the transformation progresses from a pair of separate leaves in the axil of a leaf-like bract to the partly united, then to the small and notched scale, at last to the large ovuliferous scale in the axil of a small retuse bract.

It may be stated in passing, that the first lateral bracts at the base of a shoot, in pines at least, are *not* inclined outward or toward the supporting bract, but rather decidedly inward, toward the axis, and are overlapping on the inner and upper side of the shoot, leaf-bundle, or flower.

Professor Eichler has given us a very valuable contribution towards the solution of the interesting question he treats of ; but he has not yet settled it, and it will continue to tax the ingenuity of morphologists.—*Amer. Journ. Sci. and Arts*, 3d Series, vol. xxiii.

THE FEMALE FLOWERS OF CONIFERÆ.

Professor Eichler's paper on this subject, reviewed in the May number of this Journal, has induced Professor Celakovsky to re-investigate this subject, morphologically so important, and to which he had already devoted much attention. In the Abhandl. d. K. Boehm. Ges. d. Wiss. he has recently published his present views, in an extensive

article, illustrated by a plate. After reviewing the different theories and explanations enunciated since Robert Brown's time, he dwells emphatically on the great importance of the study of the *anamorphoses* (as he calls those monstrosities which are the result of retrograde metamorphosis, in contradistinction to mere pathological alterations) and of the teachings they convey. He comes to the conclusion that these are a much safer guide than the microscopic study of the genesis of the organs, which has often misled those who too implicitly relied on its teachings. Investigating the anamorphoses of the Norway Spruce, he finds the two lateral carpellary leaves distinctly indicated and more or less separated and developed. In more evolved cases an anterior and then a posterior bract make their appearance: these, Professor Eichler had taken for a third and fourth lobe of his ligula. It must be stated here that normally the posterior bract is the third and the anterior the fourth in order. Celakovsky comes to the conclusion that, at [234] least in *Abietineæ*, Eichler's theory — that the carpellary scale is a mere emergence or ligule of the bract — is quite wrong, and that Mohl's view (1871)[1] — that the carpellary scale of these plants consists of the two connate lowest leaves of an axillary, otherwise undeveloped, bud connate at their upper edge and producing the ovules on their back, — is amply vindicated by all known morphological facts and is antagonistic to none of them.

He further concedes that the same explanation may possibly be the true one for all conifers, and that all morphologists who have treated this question thus far, have, whatever their views, assumed a conformity in this respect in all the tribes of conifers, and a complete homology of their female organs. But he thinks that this is not necessarily so, and that Sachs' and Eichler's emergence or ligular theory may be true as to *Araucarieæ*, and that thus the cone of these plants is really and truly a single flower. In regard to *Taxodineæ* and *Cupressineæ* he is convinced that an inner fruit scale really exists, completely adnate to the bract and soon outgrowing it, but he does not venture to pronounce on its nature, because he thus far has no ocular demonstration of it through any anamorphosis.[2] Professor Celakovsky concludes that the arillus of *Taxaceæ* corresponds with the ligula of *Araucarieæ*. He speaks of the *terminal* position of the ovule in this tribe as of very little morphological importance, being really a lateral ovule pushed to the top of an axis.[3]

It will be of interest to those who have been misled by contrary statements, to learn that that O. Heer, the celebrated phyto-paleontologist, has shown that geologically *Abietineæ* and *Taxodineæ* are the oldest conifers now known, appearing already in the Carboniferous period, while *Araucarieæ* come up much later in the Trias and Jurassic formations. But relative geological age of the different tribes of plants is of much less importance for the appreciation of their degree of development and their position in the system than some suppose. Thus the *Cycadeæ*, the phænogams most closely allied to the vascular cryptogams, are, as Professor Heer states, very uncertain in the Car- [235] boniferous, and make their decided appearance first in the Permian rocks: therefore much later than the higher developed conifers. — *Amer. Journ. Sci. and Arts*, 3d Series, vol. xxiv, 1882; *Bot. Gazette*, vol. vii. pp. 104–105.

PINUS SEROTINÆ, OR PINES THE CONES OF WHICH OPEN LATE, OFTEN LONG AFTER MATURITY.

Michaux was the first to notice that the cones of a certain pine of the Southeastern States "arrive at [125] maturity the second year, but do not release their seeds before the third or fourth," and he therefore named it *P. serotina*. It is now thought that this tree is scarcely distinct from the northern *P. rigida*, and I have seen specimens of the latter in which, also, some cones remained thus closed after maturity. The same fact has been observed by Dr. Chapman in a pine of Appalachicola, which he doubtfully referred to *P. inops*. Though its much more slender and delicate leaves also distinguish it from true *P. inops*, every other character is the same as in that species, so that we are justified in introducing it as *P. inops*, var. *clausa*, Chapman.

Here, then, we have two northern pines, southern forms of which show this "serotine" character. But it seems not generally known that quite a number of western and of Mexican pines also often open the scales of their cones

[1] It appears now that A. Braun has expressed the same view as early as 1842 in the French *Congrès scientifique* at Strasburg, in the report of whose proceedings it is published. He often threw out such hints from the rich treasures of his investigations, but with characteristic modesty he gave them to science without urging them or claiming scientific property or priority in them.

[2] The writer of this is in possession of a proliferous cone of *Sequoia gigantea* which seems to prove, not only that the fruit-scale in this species (and consequently in the whole tribe) is homologous with that of *Abietineæ*, in so far as it consists of leaves of an axillary shoot, yet that these leaves are not a single pair, but, as A. Braun has long ago suggested, in regard to *Cupressineæ*, that there is a number of leaves, laterally coördinate and connate, bearing a number of ovules on their back.

[3] It might be well to draw attention to the singular fact, that in the allied gymnospermous family of *Gnetaceæ*, the female flower (for such it is now assumed to be, the outer integument or utricle being considered as a two-leaved carpel) is always referred to as "terminal," whether single, double, or triple, while a terminal organ cannot be otherwise than single. The fact is that the female flowers are here axillary in the axils of one or more of the uppermost bracts, and, if single, are pushed to the top of the shoot.

long after maturity, or sometimes never. Those of our flora are *P. contorta* (with *P. Murrayana*, *P. Bolanderi*, etc.), *P. muricata* (*Edgariana*), *P. tuberculata*, and above all *P. insignis* (*radiata*, *Monteragensis*, etc.).

The following important biological questions remain as yet unanswered, waiting for the patient investigation of students, who live in the countries where these trees grow : —

1. Do the cones of these species never open as soon as ripe, but always remain closed until some time, a year or years after maturity ?

2. Do some cones open when ripe, and others of the same tree years later, and some never ?

3. Does season, locality, or individual character of the trees have any influence on this peculiarity ?

4. At what season do the late cones open, under what physical conditions, and what is the cause of any of them remaining closed forever ?

5. How many years do the seeds of such closed cones retain their vitality, and is it possible that the seeds may germinate after the cones have fallen to the ground and rotted ?

The supposition that the closed cones were sterile or contained too few seeds, did not prove correct ; it seems that all cones of the several species in question contain comparatively few seeds : the seeds of closed cones, many years old proved perfectly sweet, and therefore probably sound. — *Botanical Gazette*, vol. ii., Aug. 1877.

VITALITY OF THE SEEDS OF SEROTINOUS CONES.

On page 54 Prof. Sargent gave the results of his experiments with serotinous (closed) cones of *Pinus con-* [62]
torta, which I had collected in 1874 in Colorado, kept for more than four years in a garret, and sent to him in the spring of 1879. Seeds of cones 13 years old and 10 years old did not germinate : one out of six of 9 year old seeds, one out of eleven of 8 year old seeds, one out of three of 7 year old, and one out of four of 6 year old seeds germinated and grew up well ; those of 5 year old cones did not come up. Prof. Sargent pronounces the result to be unsatisfactory. To me it seems to be eminently satisfactory. It proved that part of the seeds from cones 5 to 9 years old had retained their vitality and that those that are older than 9 years failed; younger ones would undoubtedly have also germinated had such been experimented upon. The result shows that pine seeds of serotinous cones, or, to be more exact, seeds of *Pinus contorta*, kept under the circumstances detailed above, could and did retain their vitality a number of years, — even nine years, — while the perishable nature of pine seeds under ordinary circumstances is well known. The economy or the effect of keeping the cones closed is therefore evidently the preservation of the vitality of the seeds for a number of years beyond their maturity. What is not fully known and what will have to [63]
be investigated is how and when such seeds of serotinous cones are eventually liberated and made available, and whether not a great many of them at last perish, the cones never opening. — *Botanical Gazette*, vol. v., June 1880.

SEQUOYAH.

In last Sunday's issue you revive the almost forgotten, though most interesting history of the invention of the Cherokee alphabet and written language by the half-breed, Sequoyah, and mourn that to-day no man can point out the spot where moulders the dust of the Cherokee Cadmus.

His resting-place may be unknown, but his name and his memory live in the most magnificent vegetables of this continent. The mammoth tree of California has been claimed by English as well as Americans for their greatest men, and has been named by the former *Wellingtonia* and by the latter *Washingtonia*, but a celebrated Vienna professor, Endlicher, as eminent a botanist as he was a linguist, had already, in 1847, established a genus which comprises the mammoth trees as well as the scarcely less magnificent Red Woods of California, and had named it *Sequoia*, in commemoration of the aboriginal linguist ; and as long as botanical science exists both these wonders of the western world will perpetuate the name of the Cherokee Cadmus. — *Missouri Republican*, Sept. 28, 1873.

VIII.

PAPERS ON AMERICAN OAKS.

I. ABOUT THE OAKS OF THE UNITED STATES.

From the Transactions of the St. Louis Academy of Science, Vol. III. 1876–1877.

We have quite a large number of oaks in the United States, which for more than a [372 (1)] hundred years have attracted the attention of botanists, and we thought we knew them pretty well, i. e. we thought we could distinguish, limit, and group the species. That may have been so, to a great extent, in the old States; but when the Rocky Mountains came to be explored, and the regions west of them, new forms were discovered, and often on single specimens, and not rarely on imperfect ones, species were founded and incompletely described, so that now a straight, clear path through such intricacies is difficult to find.

A striking example of the deceptive polymorphism of these western oaks is furnished by the common Rocky Mountain scrub-oak. This interesting species grows on the foot-hills of the eastern slope of the mountains of Colorado, sparingly near Denver, scarcely north of that city, but abundantly southward, about the Pike's Peak region, and thence extends through New Mexico eastward into Texas, and westward through Utah and Arizona into Southern California. The centre of distribution perhaps, at all events the classical locality of this species, is the mountains above Cañon City, in Southern Colorado.

In the valley and on the mountain slopes about this place the oak thickets abound, 6–8 feet high, single trees occasionally 4 or 6 inches thick, and rising up to 12 or 15 feet, rarely higher. The leaves are 3–4 inches long, broadly obovate, deeply lobed, sometimes pinnatifid, underneath stellate-pubescent; the broad lobes obtuse or retuse, often again 2–3-lobed. [373 (2)] They bear middle-sized or small oval acorns, in more or less knobby, hemispherical cups. Scattered copses of these broad-leaved oaks, often of a beautiful brownish-purple in September, accompany us to within a few hundred yards of the top of the cañon, but here the character of these shrubs changes: the bushes are lower, the leaves smaller and in outline narrower, the lobes narrower and mostly undivided, but still obtuse. Now we near the precipice itself; from the ragged, dizzy edge we here and there get a glimpse of the young Arkansas, whose clear, green waters toss and foam twelve or fifteen hundred feet under us, through the inaccessible gorge, rushing toward the plains. The oak bushes accompany us even here, but now they are only 4–6 feet high, with leaves 2 inches long, ovate-lanceolate in outline, no longer lobed, but coarsely dentate, the acute teeth terminating in a sharp point: the acorns are scarcely different from those noticed before. A few steps more, and we have reached the brink of the precipice itself; oak bushes here too, but only 3 or 4 feet high, with small (1 inch long), oval, firm, almost cartilaginous, semipersistent, spiny-toothed leaves, here and there with only very few teeth or quite entire; the acorns proportionately smaller, of the same short oval shape, or often elongated from an unusually small, scarcely knobby, and sometimes peduncled cup.

We feel satisfied that we might have abundant material to characterize several distinct species, certainly 4 or 5 well-marked forms, and, indeed, they have been considered such. The first is Nuttall's *Quercus Gambelii* (*Q. stellata*, var. *Utahensis*, D.C. Prod.); the second is *Q. alba*, var. *Gunnisoni*, of Torrey; the third, with acutish lobes or coarse teeth, is Torrey's old *Q. undulata* of Long's Expedition, the first oak obtained from these mountains, and described about fifty years ago; the fourth, from the edge of the precipice itself, is what has often been mistaken for Torrey's *Q. Emoryi*, or what has been named *Q. pungens*, Liebm., in part; with it occur entire-leaved forms, which seem to unite with this as a fifth form the *Q. oblongifolia*, of the same author, and *Q. grisea*, Liebm. As a large and broad-leaved southeastern form, somewhat allied to *Q. Gambelii*, I consider *Q. Drummondii*, Liebm. In herbarium specimens they all appear distinct enough, but, looking around us, the very abundance of material must shake our confidence in our discrimination: [374 (3)] within the compass of a few hundred yards we find not only the forms above distinguished, but numbers of others, which are neither the one nor the other, but which are intermediate between them, and clearly unite them all as forms of one single extremely polymorphous species.

If one oak behaves thus, why not others? Thrown into a sea of doubt, what can guide us to a correct knowledge?

Though oaks are so common and such well-studied plants, I venture in the following pages to repeat old observations, in order to combine with them some which I think are new, and which will help to throw a little more light on the subject.

The TRUNK — its BARK, as well as its WOOD — is what we first contemplate, and this at once takes us to one of the principal points I wish to discuss.

That the *trunk* is that of a large, sometimes one of the largest, or of a middle-sized tree, or occasionally that of a shrub, even a very low one, is well known. On the Atlantic slope of the continent most species of oaks make trees, and only a few are known as shrubs; I can now recall not more than one species, the live-oak of the south, which occurs in both forms: usually an immense tree, it occasionally bears a rich harvest of fruit as one of the smallest bushes. But it is different on the Pacific slope; there we find many oaks as trees in the lower countries, and as shrubs, usually with smaller foliage and smaller fruit, in the mountains. The lesser number of oaks seem to occur solely in one or in the other of these forms.

Examining the *bark*, we at once become aware of the fact that the popular distinction of "white-oaks" and "black-oaks" is based on correct observation. The paler, ashy-gray bark of the former, and the darker, often nearly black, color of the latter corresponds, as will be shown, with other essential characters, and well marks the two principal groups of our American oaks. The bark of the white-oaks is inclined to be scaly or flaky, that of the black-oaks is usually rougher, and deeply cracked and furrowed.

The *wood* of the white-oaks is tougher, heavier, and more compact, — the only oak-wood which is fit to be used by the wheelwright or cooper, and is for their purposes unsurpassed. The wood of the black-oaks is brittle and porous, makes poorer firewood, and, made into [375 (4)] barrels, holds only dry substances. Undoubtedly the microscopical investigation of both classes of oak-wood will scientifically establish and confirm these distinctions.

While many other trees, such as Pines, Walnuts, Hickories, Gleditschia, etc., grow rapidly in the first decades of their life, and make narrower and narrower annual rings as they grow older, the oaks either hold their own, the annual rings being as wide in age as they are in youth, or they grow more rapidly after the first 50, or 100, or even 150 years of their existence.

The WINTER-BUDS, especially the terminal ones, show some characteristic differences; they are larger or smaller, acute or obtuse, smoothish, or hairy, or tomentose; *Quercus Garryana* can be readily distinguished from all the allied Californian oaks by its large, pointed, tomentose winter-buds.

In the LEAVES, so extremely variable in form, certain types are generally recognized. It is not here the place to expatiate on these well-known topics; but I may be allowed the observation, that those oaks, which in the perfect state have deeply-lobed or pinnatifid leaves, show in young shoots or on adventitious branchlets less divided or only dentate, sinuate, or even entire leaves (e. g. *Q. alba, stellata, falcata, coccinea, palustris,* etc.), while, singularly enough, the oaks whose leaves in the adult tree are entire or nearly so, often have on the young shoots dentate or lobed leaves. I need, for examples, only refer to *Q. aquatica, Q. Phellos,* and *Q. virens;* and even *Q. nigra* belongs here.

The *vernation* of the oak leaves has sometimes been mentioned as conduplicate, meaning that the upper sides of both halves of the nascent leaf are applied together, and this really is the case with most oaks which I have been able to examine in this early stage. We find it both in white and black oaks, — almost always, I believe, in those with broad and deeply-lobed leaves; I mention only *Q. alba, macrocarpa* and *Garryana, Q. coccinea* and *palustris,* and also the forms allied to *Q. Prinus,* even those with narrower, dentate leaves. In the more deeply-lobed, broad-leaved black-oaks, the two halves of the leaf are, besides, plicate parallel with the principal nerves.

Next to these range the oaks with the young leaves concave and imbricately covering one another. Such we find in *Q. stellata* of the first, and *Q. nigra* of the second [376 (5)] group, both with densely tomentose, thick, young leaves. In other oaks, mostly such as have broader and more or less entire leaves, the young leaves imbricatively cover one another like those last mentioned, but are convex on the upper side, with the edges turned down or back. Such is the case in *Q. cinerea, myrtifolia, agrifolia, aquatica, chrysolepis,* and, I believe, also in *Q. undulata,* and in *Q. Wislizeni.* I find the same to be the case in the deeply-lobed *Q. falcata.*

The narrow-leaved oaks of both sections have revolute young leaves, the halves being spirally rolled backward towards the midrib, so that only the upper side of the leaf is exposed; the point of the young leaf is somewhat spreading so that the branchlet has a squarrose appearance, while in those with imbricative vernation it is compact. I find the revolute leaf in *Q. virens, pumila, Phellos, heterophylla,* and *imbricaria.* In *Q. Catesbœi* I observe an inflexed vernation, the long bristle-pointed lobes of the nascent leaf being curved down over the still younger one.

I believe that the characters of vernation will not only help to distinguish allied species or doubtful varieties, but will also assist in unravelling the intricate questions of hybridity.

The young leaves of almost every oak are coated with a dense stellate down, which in some (*Q. alba, rubra,* etc.) is early deciduous, or it disappears later, or is entirely persistent. Besides these stellate one-celled hairs, several species, those with a clammy feeling of the young leaf, have another kind of hair, single or a few stellately connected, consisting of several cells, obtuse or clavate, sometimes branched, and often colored, apparently glandular. I notice these articulate hairs, among the white-oaks, in *Q. stellata,* and less conspicuously in *Q. macrocarpa;* among the black-oaks, in *Q. nigra, myrtifolia, cinerea, falcata, aquatica,* and *laurifolia;* in *Q. chrysolepis* the characteristic "golden scales" are no scales, but consist entirely of such articulated yellow hair, and the young *Q. Catesbœi* has the same rusty coating.

The *venation* and more or less distinct *reticulation* of the leaves also present characters not to be neglected; by them, e. g. two easily confounded Californian oaks, *Q. agrifolia* and *Wislizeni,* can readily be distinguished even in sterile branchlets.

The persistence of the leaves is a good character in some species, while in others it is [377 (6)] unreliable; *Q. pumila* and *laurifolia* on the eastern and *Q. agrifolia* on the western coast sometimes retain their leaves until the new ones are fully developed, and other specimens, even in the same neighborhood, lose them before the buds swell; some have deciduous leaves northward and partly persistent ones southward. The broad-leaved forms of *Q. undulata* are decidedly deciduous, while those with small, coriaceous, spiny-toothed leaves retain them through part of the winter, or, toward their southwestern limit, even into summer. Only such oaks ought to be called evergreen

which retain the greater part of their old leaves at least until the new ones are fully grown; the leaves of some oaks persist even into the third year.

The MALE FLOWERS are important for the diagnosis of some species, and to some extent even for the grouping of them. I pass by the form and pubescence of the bracts and of the calyx lobes as well as the pubescence of the anthers (among all our oaks only observed in *Q. stellata* and *virens*): even the sometimes present cusp or point of the anthers seems to be of lesser value, because variable in some species. Of greater importance is the size and the number of the anthers. The smaller and more numerous (usually from 5 to 8 or even 10, rarely only 4) occur in the white-oaks, while in the black-oaks the anthers are usually larger and fewer, as a rule only 4, in some species as many as 5 or 6; only in *Q. agrifolia*, which also shows other abnormal characters, 6–8 stamens are the rule, and sometimes 10 are found. The pollen-grains of both groups have a diameter of about 0.03–0.04 mm.

In numerous flowers of a certain tree of *Q. nigra* I have seen abortive pistils with prominent filiform styles,—singularly enough always 2, where we might have expected 3. In flowers of *Q. agrifolia* the connective of the anthers was seen to elongate, the cells to dwindle down and finally to disappear.

The FEMALE FLOWERS furnish valuable characters to distinguish the principal groups of our oaks. The pistil consists normally of 3 carpels and 3 stigmas; not rarely 4 occur, and in some Californian species (*Q. agrifolia* and *Wislizeni*) I have repeatedly seen as many as 5. The stigmas in our species are dilated, retuse, or emarginate; in the white-oak group they are sessile, or [378 (7)] rarely (and that sometimes in the same species) borne on short, more or less erect, styles; in the black-oaks we always find them on longer, patulous, or recurved styles.[1] As the stigmas are measurably persistent, we often recognize this difference even in the mature fruit.

The FRUIT exhibits the most important characters in the period of its maturation, first noticed by Michaux, and especially in the position of the abortive ovules, the beautiful discovery of A. De Candolle. But before I speak of these I must allude to the position of the fruit on the branch. It is single or clustered in the axils of the leaves or their scars, sessile, or more or less peduncled. In the black-oaks the peduncle is short or missing, but in the white-oaks it is sometimes several inches in length; its presence, however, is of very little specific value, as in many species either sessile or peduncled acorns are found. In some oaks this feature is connected with slight differences in the length of the petiole or the shape of the leaf; the distinction between the European *Q. Robur* and *Q. pedunculata* is based on such differences, and we have an analogous difference in our *Q. alba*, where, at least here in the Mississippi Valley, the form with deeply pinnatifid leaves has usually peduncles as long or little shorter than the acorn, and the other form with more broadly-lobed leaves has shorter peduncles or sessile fruit; but sometimes we find sessile and peduncled fruit on the same tree. Some white-oaks have always sessile or nearly sessile acorns, as *Q. stellata*, while *Q. bicolor* always bears them on long peduncles.

The acorns mature either in one season or in two, and generally speaking we find the annual maturation among the white-oaks and the biennial maturation in the black-oaks, but the exceptions to this rule prove that this peculiarity is not necessarily connected with the essential characters of the two groups. We have one western white-oak, *Q. chrysolepis*, with biennial fruit, and three black-oaks with annual maturation, *Q. pumila* of the east, and *Q. agrifolia* and *Q. hypoleuca* of the west.

The biennial maturation is easily recognized in the oaks with deciduous leaves; the tree is never without younger or older fruit, or, from May to September, with both; the older [379 (8)] acorns are then seen on the older, leafless part of the branchlet, and the young, incipient ones on the younger, leafy part. In oaks with persistent leaves some difficulty may arise from the pecu-

[1] A group of white-oaks with biennial fructification, peculiar to southern Europe and eastern Asia, the best known representatives of which are *Q. Cerris*, *Q. Pseudo-Suber*, and *Q. occidentalis*, differs from all these by their patulous or recurved styles bearing ligulate, acutish stigmas.

liarity that the branchlets which had flowered the previous year, and are now maturing the fruit, often in the second year do not elongate or make new leaves or new wood, — in short, do not perform any function but the maturation of the fruit. In this case the fruit is found near the end of the branchlet, absolutely as if it were an annual fruit; but the appearance of the leaves as well as of the epidermis of the branch proves them to be over a year old, and wherever a new shoot of the present year can be discovered, the difference between this and those of the last year easily solves any doubts. In *Q. chrysolepis* this peculiarity is quite striking; very rarely (at least in the herbarium specimens examined by me) the fruit-bearing branchlets elongate and again bear flowers, which is the rule in our deciduous biennial oaks.

The cup of the acorn, an involucral organ, is in all our species covered with imbricated scales, appendicular organs which simulate bud-scales, and even occasionally seem to assume a pseudo-phyllotactic arrangement. In the black-oaks these scales are membranaceous and never thickened at base; in the white-oaks, on the contrary, they sometimes have herbaceous tips and, at least the outer and lower ones, are always more or less thickened, inflated, or knobby at base; they are very thick, e. g. in *Q. alba* and *lobata*, and very slightly thickened in *Q. stellata* and *Garryana;* in *Q. macrocarpa* they are herbaceously tipped.

The shell of the nut or acorn is thinner in the white-oaks and thicker in the black-oaks; a much more important and striking character is, that in the former its inside is dark, smooth, and even shining, or rarely pubescent, and in the latter densely silky-tomentose, a difference which, I believe, is constant.

Only one of the 6 ovules of the oak-ovary is developed, while the 5 others persist as small but distinctly recognizable oval, dark colored, pendulous bodies, outside of the seed-coat, — in the white-oaks at the base of the perfect seed, in the black-oaks just below its tip. Only in one of our species, *Q. chrysolepis*, are they intermediate or lateral, in some acorns almost basal, and in others scattered over the side from near the base to two-thirds up. DeCandolle has observed the [380 (9)] same in the cork-oak of Europe and in some Mexican white-oaks. The black-oaks with annual fructification have these ovules always suspended near the tip of the seed, and are in this respect undistinguishable from the regularly biennial black-oaks.

It is well known that in the southeastern live-oak both cotyledons are united into one mass, — a singular but isolated fact which has no systematic significance.

In the foregoing pages I have purposely left aside the very peculiar Californian *Q. densiflora*, which is in every respect different from the other oaks, and thus far the sole representative of a peculiar group named by DeCandolle *Androgyne*. In many respects it is more a chestnut than an oak, for it has, just like the chestnuts, the same dense-flowered, erect male spikes, 10 stamens to each flower, very small anthers on long filiform filaments, with very small pollen-grains (0.017 mm. in diam., not much more than half as large as in other oaks), and in the female flowers slender, terete, pointed stigmas, grooved above. In place of the spiny involucre of the chestnut our plant has a spiny cup, and is thus made an oak and not a chestnut. The maturation is biennial. The shell of the nut is thicker and harder than in any other of our oaks, the inside thickly tomentose, and the abortive ovules are found near the top of the seed. The wood is brittle and worthless.

It results from these investigations that our oaks, leaving again aside the one last mentioned, arrange themselves into two great groups, often alluded to above as the white-oaks and the black-oaks.

The *white-oaks* are characterized by paler, often scaly, bark, tougher and denser wood, and sessile or subsessile stigmas, and bear the abortive ovules at the base or rarely on the side of the perfect seed. Besides this, the leaves and their lobes or teeth are obtuse, never bristle-pointed, though

sometimes spinous-tipped; their stamens are more numerous, the scales of the cup more or less knobby at base, the inner surface of the nut glabrous or (rarely) pubescent; the fruit generally matures in the first year.

The *black-oaks* have dark, furrowed bark, brittle and porous wood, styles long and [381 (10)] spreading or recurved, abortive ovules always near the tip of the perfect seed. The leaves and their lobes are bristle-pointed, at least in youth; lobes and teeth acute; teeth sometimes spinous. Their stamens are usually less numerous, the scales of their cup membranaceous, the inner surface of their nut always tomentose; the fruit generally matures in the second year.

We may then arrange our oaks in the following order:—

QUERCUS, Linn.

I. LEPIDOBALANUS, Endl.: Amenta mascula pendula; pollinis cellulæ 0.03–0.04 mm. latæ; flores feminei a masculis distantes; stigmata dilatata.

A. Leucobalanus: Ovula abortiva infera vel raro lateralia; stamina plerumque 6–8; stigmata sessilia vel subsessilia; nux intus glabra s. rarissime pubescens.

* Maturatio annua; nux intus glabra; ovula abortiva infera.

† Folia decidua.

Q. lyrata,[1] *macrocarpa,*[2] *alba, lobata, stellata, Garryana, bicolor, Michauxii,*[3] *Prinus,*[4] *prinoides, Douglasii, undulata.*[5]

†† Folia sempervirentia.

Q. dumosa,[6] *Emoryi,*[7] *reticulata,*[8] *virens.*[9]

** Maturatio biennis; nux intus pubescens; ovula abortiva infera vel lateralia; folia sempervirentia.

Q. chrysolepis.[10]

B. Melanobalanus: Ovula abortiva supera; stamina plerumque 4–6; styli elongati demum recurvi; nux intus sericeo-tomentosa.

* Maturatio annua; folia persistentia s. subpersistentia.

Q. agrifolia,[11] *hypoleuca,*[12] *pumila.*[13]

** Maturatio biennis.

† Folia decidua.

Q. palustris, rubra, Sonomensis, coccinea,[14] *ilicifolia, Georgiana, Catesbœi, falcata, nigra, cinerea,*[15] *aquatica, laurifolia,*[16] *heterophylla,*[17] *imbricaria, Phellos.*

†† Folia sempervirentia.

Q. Wislizeni,[18] *myrtifolia.*[19]

II. ANDROGYNE, A. DeC.: Amenta mascula erecta, basi flores femineos gerentia; pollinis cellulæ fere 0.017 latæ; stigmata linearia.

Q. densiflora.

NOTES.

1. Quercus lyrata, *Walt.*, extends as far north as *Taxodium* does, to the banks of the lower Ohio in Illinois.

2. Q. macrocarpa, *Michx.*, is extremely variable in the size of its acorns, and especially in the depth and the margin of its cup, which sometimes covers the acorn scarcely one-half, usually three-fourths, and [382 (11)] occasionally entirely; the margin is profusely or sparsely fringed. — Throughout the north-west, north of the Missouri River, a low scrubby form is found, which might be designated as var. *depressa*, as it is undoubtedly the *obtusiloba* β. *depressa*, Nutt. Gen. 2, 215, which has smaller leaves and much smaller acorns than the species, but is clearly a form of *macrocarpa*.

3. Q. Michauxii, *Nutt. Gen.* 2, 215, *excl. syn.* — The figure of Michaux, quoted by Nuttall, refers to *Q. bicolor*, and none of his figures represent our plant. Elliott adopts Nuttall's name, but Chapman as well as DeCandolle consider it a form of *Prinus*. *Q. Prinus* was described by Linnæus with *foliis obovatis utrinque acuminatis*, which sufficiently well agrees with all the forms of *Prinus* proper. Our plant is distinguished by having the leaves obtuse, or mostly cordate, at base; thicker, more leathery, and tomentose, on the lower side; and the male flowers 10-androus. All the forms of *Prinus* proper have a very deciduous pubescence on the lower side of the leaf, which is acute or acutish at base.

4. Q. Prinus, *Linn.*, would then comprise Michaux's varieties, *palustris*, *monticola*, and *acuminata*.

5. Q. undulata, *Torr.*, has been treated of in the introduction to this paper; the different forms, there also enumerated, are α. *Gambelii* (*Q. Gambelii*, Nutt. and probably *Q. Drummondii*, Liebm.); β. *Gunnisoni* (*Q. alba*, var. *Gun-*

nisoni, Torrey) ; *γ. Jamesii*, Torrey's original plant, figured in Ann. Lyc. N. Y. 2, t. 4, the original figure reproduced, with slight alterations in Nuttall's N. Am. Sylv. 1, t. 3 ; *δ. Wrightii*, often confounded with *Q. Emoryi*, and apparently one of the forms comprised by Liebmann in his *Q. pungens*. *Q. oblongifolia*, Torr., and *Q. grisea*, Liebm., seem to be forms with more or less entire leaves : or the latter may perhaps have to be referred to the Mexican *Q. microphylla*.

6. Q. DUMOSA, *Nutt., N. Am. Sylva*, 1, *p.* 7 ; *Torrey, Bot. Mex. Bound. p.* 207. *Q. acutidens*, Torr. ib. tab. 51, is a larger form of the same. *Q. berberidifolia*, Liebm., DC. Prod. 16, 2, p. 36, seems to belong here either entirely or at least in part. A shrub of the southern part of California, often very squarrose, sometimes with slender and erect branches ; leaves oval, obtuse, often cordate or obtuse at base, spinous-dentate or sometimes entire, dark green above, hoary tomentose or pubescent below, from $\frac{1}{4}$ to $\frac{3}{4}$ or sometimes 1 inch long ; fruit sessile ; cup strongly tuberculate, black, between 2 and 6 lines in diameter ; acorn large for the size of the plant, oval, or small and narrow.

7. Q. EMORYI, *Torr.* Emory Rep. 1848, p. 151, t. 9. *Q. hastata*, Liebm. Quite distinct from *Q. undulata*, var. *Wrightii*, which is often confounded with it ; the peduncled acorns of Torrey's figure belong to that form of *undulata*. This pretty Arizonian species was collected by Emory in 1846, and soon afterwards by Wright, and then not again until Dr. Rothrock, a year or two ago, brought back fine specimens from Lieut. Wheeler's Expedition. The leaves are not roundish or oval and pale as in *Wrightii*, but lanceolate, cordate at base, and dark green ; the acorns in all the specimens seen by me are sessile, the bright brown scales of the cup only slightly thickened [383 (12)] at base.

8. Q. RETICULATA, *HBK.*, has been found in Southern Arizona by Dr. Rothrock, in the expedition just mentioned.

9. Q. VIRENS, *Ait.* A shrubby form is var. *maritima*, Chapm., *Q. maritima*, Willd., from which var. *dentata*, Chapm. cannot be separated ; both have shorter and often larger acorns on shorter peduncles than the species ; the former is the larger shrub, rarely as much as 10 feet high, with usually entire lanceolate leaves ; the latter often bears fruit when only 1–1½ feet high ; leaves sometimes dentate or sinuate-dentate, 1–2 inches long ; vigorous ground shoots occasionally produce broad oval, entire, or dentate leaves, 3–4 inches long and 1½–2½ wide.

10. Q. CHRYSOLEPIS, *Liebm.*, has so often been spoken of in the foregoing pages that little need be added. Its fructification was misunderstood until the abundant material brought together by Prof. W. H. Brewer for the California State Survey, permitted me to clear it up. The size of the plant, of the leaves, and of the fruit, is extremely variable ; and even the yellow pubescence, which has given it its name, is neither persistent, nor is it present in all cases. Young vigorous shoots or young trees have spiny-dentate leaves ; older trees, especially on fertile branches, usually entire ones. The acorns are sometimes very large and the shallow cup extremely thick : this is the form Torrey (Pacif. R. R. Rep. v. 365, tab. 9) has described as *Q. crassipocula ;* Dr. Parry sends from San Bernardino still larger cups, 1¾ inches in the outer diameter. Dr. Kellogg's *Q. fulvescens*, in Proc. Calif. Ac. 1, 67 and 71, seems (from specimens seen in Hb. Brewer) to refer to the form with middle-sized acorns and cups of the ordinary shape, without that unusual thickening ; his *Q. vacciniifolia*, ib. 1, 96 (106 ed. 2) is a small-leaved mountain form. Of this variety specimens are found entirely destitute of the yellow, scurfy pubescence even in the earliest youth. The anthers of this species, usually 10 in number, are always strongly pointed ; the broad stigmas are closely sessile. The lateral position of the ovules has been mentioned.

11. Q. AGRIFOLIA, *Née*, the first western oak that became known (1802), is quoted by the author as inhabiting "Nootka Sound" and California, perhaps by mistake, as now it does not seem to be known much north of the Bay of San Francisco, and it extends as far south as the southern boundary of the State, but does not ascend the mountains. It is a fine large almost evergreen tree, but makes miserable timber and even poor firewood. The old leaves partially fall off in winter, so that the heads begin to look less dense toward spring; in some trees the last leaves have fallen before the young ones are developed, but generally they do not come off entirely before the young verdure covers the branches. Dr. Bolander remarks that occasionally odd-looking trees are observed which in spring retain all their old leaves without bringing forth flowers or young shoots, — a state of things which resembles the condition of *Q. chrysolepis*, above alluded to ; that species, however, performs the function of maturing its fruit, though it bear [384 (13)] no young leaves, while in this case there would be in spring an almost absolute winter-like stagnation of the vegetation. It has certainly an annual fructification, but is in every respect, except in the number of the large stamens (6–8 and often more), a regular black-oak. The acorn is always long pointed, whence the name Torrey gave it, *Q. oxyadenia* (Sitgr. Rep. tab. 17), is not inappropriate.

A southern variety of this species is shrubby, with smaller leaves, occasionally pubescent, and with smaller but very abundant fruit. From the often very similar *Q. Wislizeni* it can, even without fruit, always be distinguished by the dull, pale upper surface of the leaves, which is usually convex, and by the absence of reticulation on it.

12. Q. HYPOLEUCA, I name an Arizona oak which Torrey, in Mex. Bound. Rep. p. 207, refers to *Q. confertifolia*, HBK., a species with biennial fructification and slightly pubescent leaves. Our plant is characterized, besides its

annual acorns, by lanceolate thick leaves with revolute margins, and a white tomentose lower surface. The 5-lobed calyx is scarcely hairy and bears 4 stamens; no bracts seen, even before the flowers open.

13. Q. PUMILA, *Walt. Fl. Carol.* p. 234 ; *Michx. Sylv. tab.* 17 (where the fruit is erroneously represented as biennial, otherwise the figure is good). This interesting shrub, though first described nearly a century ago, has only, through the efforts of Dr. J. H. Mellichamp, become properly known in the last few years. Living in the immediate vicinity of its habitat, the pine barrens of the low country of South Carolina, this acute observer has aided me in the most liberal manner in studying this as well as other difficult oaks of that region.

Q. pumila is called the *running-oak* because, by the aid of its wide-spreading stolons, it covers large patches, sometimes acres, with its thickets. It is often, especially where kept down by the frequent fires, only 1–2 feet high, and has been seen loaded with flowers when only of 6 inches; in other localities it grows 8–10 feet high, with stems 1 inch in diameter. The leaves, revolute in vernation, are usually about 2 inches long, lanceolate, entire, and often undulate, only occasionally dentate-lobed, but in vigorous shoots sometimes broad ovate and deeply and acutely lobed; another form has obovate obtuse leaves. They are slightly pubescent when young, but soon become quite glabrous, persist through the winter and occasionally beyond the flowering period. In the male flowers I find pretty regularly 4 stamens, and in the female 3 long recurved styles. The globose fruit in its shallow cup is nearly sessile in the axils of the same year's leaves. — *Q. pumila*, Walt., Michx. Sylv., Nutt. Gen., Elliott Flor. *Q. Phellos*, var. *pumila*, Mich. Querc. & Flor. *Q. cinerea*, var. *pumila*, Chapm., A. DeCand. Prod.

Var. *sericea* has similar narrow, or larger, ovate-lanceolate leaves, always silky-white underneath; the larger leaves on fertile branches grow over 4 inches long by 1¼ inches in width, and on sterile shoots even larger. — *Q. sericea*, Willd., Pursh. *Q. Phellos*, var. *sericea*, Ait.

Over a year has passed since the foregoing part of this paper was published; of the [385 (1)] concluding seven pages, only a small edition, for private distribution, was then printed.* Continued study of the genus, aided by numerous kind communications of observations, as well as of specimens, have enabled me to make the following corrections and additions.

Page 374, l. 22. Low, shrubby forms of *Q. stellata* occur on the southeastern sea-coast, and of *Q. macrocarpa* on the northwestern plains.

L. 2 from below ought to read: the only oak wood. — The wood of *Q. Prinus*, however, makes an exception, being more porous than most other white-oak woods.

A careful study of the numerous American oak woods displayed by the Agricultural Department and by different States, at the Centennial Exhibition in Philadelphia, has revealed further interesting facts. The black-oaks grow, on an average, nearly twice as fast as the white-oaks, and if *Q. nigra* and the evergreen black-oaks be left aside, the disproportion will be found still greater. In the average of 20 different white-oaks, from all parts of the country, I find the growth nearly equal through the first 40 years; in 14 specimens of black-oaks the growth is more rapid in the first 30 years than between the 30th and 40th. The following little table will exhibit this more distinctly.

Average Width of the Annual Rings.

	in 20 white-oaks:	in 14 black-oaks:
In the first 20 years	0.8 lines.	1.6 lines.
From the 20th to the 30th year	0.8 "	1.7 "
" 30th " 40th "	0.7 "	1.2 "

The heartwood of the white-oaks is always readily distinguishable from the sapwood by its darker color, varying between dark gray and light brown, but in the black-oaks the heartwood is scarcely darker than the sap, and in some species or some individuals cannot be distinguished at all. Only in *Q. nigra* and the curious *Q. Emoryi* is it often irregularly mottled with black.

In the limited number of specimens which I could examine, the sap turned into heartwood,

	in 19 white-oaks,	in 8 black-oaks,
after	22 years,	17 years,
having attained a thickness of	18 lines,	21 lines.

Only in these 8 black-oaks a line of demarcation was visible.

* The pages referred to (385–391, 14–20 of the private edition), which we omit from this reprint, were replaced by similarly numbered pages in the Transactions of the Academy (pp. 1–7 of the reprint of this second part), as directed in a slip distributed with it. — EDS.

In a geographical point of view, we notice that the black-oaks of the present day are confined to [386 (2)] America, and are principally developed in the Atlantic part of North America. We have there 15 species, including a single abnormal type, while west of the Great Plains and on the Pacific slope only 5 species occur, 3 of them receding from the normal type. Numerous black-oaks are found in Mexico and Central America; in DeCandolle's Prodromus 20 are enumerated with known maturation, and of 18, of which the fructification is not ascertained, some may also belong here. In the tertiary period the black-oaks, it seems, extended into the Old World, just as many other recent North American types did.

The white-oaks are more uniformly distributed over the temperate parts of the northern hemisphere. We have on the Atlantic slope 8 species, and 9 in the western half of the continent, only 2 of the latter abnormal.

Thus we have in our flora nearly as many white-oaks as black-oaks; but while the former are nearly equally distributed between east and west, the latter predominate eastward.

Page 375. *Vernation* — A too hasty examination, partly of specimens too far advanced, has led me into several errors. The vernation is *conduplicate* only in part of the white-oaks (in the European type of the genus, *Q. Robur;* in our *Q. alba, macrocarpa, Garryana,* and in all the species of the Prinus group; probably in *lyrata, Douglasii,* and *lobata*). The *imbricate* vernation is the rule for the balance of the white-oaks (*Q. stellata, undulata, dumosa,* and *chrysolepis*) and for all the black-oaks, with the exception of the few species (p. 376) with *revolute* vernation. In the oaks with imbricate vernation the outer leaves are always imbricate, but the inner ones are imbricate or flat or even slightly revolute on the margins in the species with thicker, firmer leaves (*undulata, dumosa, chrysolepis; Emoryi, agrifolia, nigra, aquatica, laurifolia, cinerea, myrtifolia*). In the others, with broader and more lobed leaves (*coccinea, rubra, palustris, falcata,* etc.) the 2 or 3 innermost leaves are conduplicate. The inflexed vernation mentioned as occurring in *Q. Catesbæi,* is also occasionally seen in *falcata,* evidently in oaks with slender-lobed leaves, but it is by no means constant, and of no specific value.

The suggestion that the character of vernation would be an important assistance in classification, and in [387 (3)] the discovery of alliances of hybrids, has been verified by actual observation, as will be shown below.

Page 376. The glandular colored pubescence appears on both sides of the young leaves in *Catesbæi, sinuata,* and *myrtifolia;* on the lower side in *chrysolepis* and somewhat in *stellata;* on the upper side in *falcata,* and also in *Catesbæi-laurifolia.* I do not find this pubescence on seedlings of these species, nor is it often seen on the youngest leaves, but becomes developed when the leaf has attained $\frac{1}{4}$ to $\frac{1}{2}$ of its full size.

The *reticulation* is generally more marked on the upper than on the lower side of the leaves, and in the black-oaks more than in the white-oaks; an exception occurs in *Q. falcata* and (as already indicated) *agrifolia;* in both the upper surface is almost smooth; in *cinerea* and *ilicifolia* the reticulation is much less prominent than in most others.

Page 377. The male aments are produced from scaly buds which are not further developed, or from the lower part of branchlets, usually in the axils of bud-scales, or rarely from the axils of the lowest leaves; thus often in *Q. agrifolia.* They are mostly simple, but in *chrysolepis* I find them often branching, such as they are described in the Asiatic section *Pasania.*

Page 378, l. 16 and 17, strike out the comma after "connected," "differences" and "petiole." Add *in* before "the shape."

L. 33. *Four* black-oaks with annual maturation, including *Q. Emoryi.*

Page 379, l. 22. Occasionally black-oaks are found with cup-scales thickened at base; Prof. Sargent has collected near Cambridge fruits of *ilicifolia* with this peculiarity, and it does not seem to be rare at all in northern forms of *rubra.*

L. 6 from below. The abortive ovules are not oval and pendulous, but rather bottle-shaped bodies, suberect in the white-oaks, hemitropous in the black-oaks.

Page 380, l. 5. *Q. Emoryi,* in every other respect a true black-oak with annual fructification, has basal ovules, — another remarkable instance of mere botanical characters not always coinciding with essential ones. Hence the word "always," in the first sentence of the following page, must be qualified by adding *almost.*

Page 381. The following is believed to be a more correct enumeration and more natural arrange- [388 (4)] ment of our oaks.

I. LEPIDOBALANUS, Endl.

A. LEUCOBALANUS.

* Maturatio annua.

† Folia decidua.

Q. alba, lobata (*fruticosa* [1]), *Garryana, stellata, macrocarpa, lyrata, bicolor* (*Michauxii*), *Prinus, Mühlenbergii* (*prinoides*), *Douglasii, undulata* (*pungens*).

† † Folia persistentia.

Q. oblongifolia, dumosa, reticulata, virens.

[1] The names in parentheses designate subspecies.

* * Maturatio biennis.

Q. chrysolepis (*vacciniifolia, Palmeri*), *tomentella.*

B. MELANOBALANUS [2]: Ovula abortiva (excepta *Q. Emoryi*) supera, etc., ut in pag. 381.

* Maturatio annua, folia persistentia.

Q. Emoryi, agrifolia, pumila, hypoleuca.

* * Maturatio biennis.

† Folia decidua.

Q. rubra, coccinea, (*tinctoria*), *Sonomensis, falcata, Catesbœi, ilicifolia, palustris, Georgiana, aquatica, laurifolia, nigra, cinerea, imbricaria, Phellos.*

† † Folia persistentia.

Q. Wislizeni, myrtifolia.

II. ANDROGYNE, A. DC.

Q. densiflora.

ADDITIONAL NOTES.

Q. LOBATA, *Née*, has heretofore been known only as a large tree with slender, even pendulous branches, deeply lobed or pinnatifid leaves, the lobes often retuse, notched or again lobed, pubescent below; with large, long, conical-pointed (therefore *longiglanda*, Torrey) acorns in a deep, almost always strongly tuberculated cup. No essential variation of this type has been noticed, unless we class a shrub-oak here, 2–6 feet high, which Prof. Brewer found on the mountains west of Shasta, and Mr. Lemmon near the Tuolumne River. The foliage is the same as that of *lobata*, perhaps smaller and even more deeply lobed, but the large oval acorns have their base scarcely immersed in a very shallow cup; cup 8–9 lines wide, 3–4 high; acorn 12–15 lines high, sessile or (in the Tuolumne specimens) [389 (5)] peduncled. The form of the acorn and cup might justify me in considering this bush as a distinct species, but, well aware of the extreme variability of the western oaks, I provisionally append it to *Q. lobata* as a subspecies under the name of *fruticosa.*

Q. GARRYANA, *Dougl. ap. Hook.*, well known in California by the name of mountain white-oak, though not found in the higher mountains; it extends farther north than any other oak on the west coast and is the only representative of the genus north of the Columbia River, is common on Vancouver Island (where a variety has been called *Q. Jacobi*, R. Br. min.) and according to Prof. Dawson has been met with sparingly on Frazer River; on the Columbia it extends as high up as the Dalles; in exposed northern situations it is scrubby. Southward it seems to be limited by San Francisco Bay. It can always be readily distinguished by its rather large, variously but commonly deeply-lobed thick leaves, tomentose or downy beneath, and by its large (3–5 lines long) tomentose winter buds. *Q. Neœi*, Liebm. (Hartweg, in Hb. Gray) is a form with more knobby cups.

Q. STELLATA, *Wang.* (*Q. obtusiloba*, Michx.), is of a uniform character in the middle States, but varies considerably southward. Dr. Mellichamp finds on the coast of South Carolina, 1. a scrub form, often with almost entire, undulate or angular leaves mixed with other shrubs or trees of the normal foliage; 2. a tree with normal leaves but glabrous branchlets and glabrous anthers; and 3. a tree with flaky bark, and narrow, cuneate leaves with oval lobes, and like the branchlets glabrous; anthers unknown. The last two may prove to be hybrid forms between *stellata* and *alba*, for which see further on.

Q. MACROCARPA, *Michx.*, often occurs in the north and northwest with unusually small oblong acorns, half or more covered by the mossy cup, when it is *Q. olivæformis*, Michx.; another form has oval acorns of the size of those of *coccinea* in a shallow, mossy cup; on the lower Ohio acorns have been gathered 15–16 lines in diameter, in a very mossy cup over 2 inches wide. The leaves vary from the nearly entire, obovate, sinuate-dentate to the lyrate-pinnatifid form with almost naked midrib. The branchlets, always thick, are either corky or smooth.

Q. LYRATA, *Walt.*, originally known from the banks of the southeastern rivers, is also found in the damp woods of the lower Ohio and down the Mississippi River. It properly stands between *macrocarpa* and *bicolor*, and has a good deal of both. I have seen from the same localities (Mount Carmel on the lower Wabash, *Dr. J. Schneck*, and Memphis, *A. Fendler*) specimens with the typical enclosed acorns, and others with cups, somewhat mossy on the edge, only half enclosing the acorn. The bark is flaky like that of *bicolor.*

Q. BICOLOR, *Willd.*, is generally a well characterized tree with flaky bark, cuneate-obovate, coarsely sinuate-dentate leaves, white below, 6–8-androus flowers, and large acorns in long-peduncled, mossy cups; but numerous aberrant forms occur, some with light downy leaves and green below, others with much smaller [390 (6)] or longer acorns; in some the cup is scarcely fringed.

[2] The black-oaks, many years ago, were grouped by Spach, and later by Liebmann and others, under the name of *Erythrobalanus* (red-oaks), but with other characters and other limits than I assign them.

Q. Michauxii, *Nutt.*, such as it appears in the south and up to the lower Delaware River (*Michaux, Canby, Commons*), and to the lower Ohio (*Dr. Schneck*), would seem to be a well-marked species ; but my notes, p. 382, based upon too few specimens from a single locality, are not quite correct. It is certainly *Q. Prinus palustris* of Michaux (the *Q. P. discolor*, quoted by Nuttall as synonym, is *Q. bicolor*). The tree grows in low grounds; has a gray, flaky bark ; leaves (usually large, 5–6 inches long) oval or obovate, regularly (commonly not deeply) dentate acute, obtuse or even cordate at base, generally thick and very soft downy below, rarely only slightly pubescent or even almost glabrous (in Delaware, *A. Commons*) ; male flowers mostly 10-androus ; fruit the largest of the Prinus group, short-peduncled, cup shallow, obtuse or flat below, with deltoid, acute, rigid, distinctly imbricate scales, without any fringe. — Distinct as this tree seems to be, a series of forms, apparently common from the Delaware (*Canby, Commons*) to the Potomac (*L. F. Ward, Dr. Vasey*), evidently unite it, contrary to the views of most American botanists, with *Q. bicolor*. DeCandolle (Prod. l. c. p. 20) already assumed their identity ; he, however, on the next page, wrongly quotes Michaux's *Q. P. palustris* for *Q. Prinus*. The leaves of this intermediate form are in some instances purely those of *bicolor*, in others more those of *Michauxii ;* the acorns are subsessile, middle sized, with a deeply hemispherical cup, and less regular, often knobby and sometimes appendaged scales. If these connecting forms were not so common in the region mentioned, I might feel inclined to take them for hybrids between two distinct species ; as it is, I must consider *Q. Michauxii* as a subspecies of *bicolor*.

Q. Prinus, *Linn.* *Q. Prinus monticola*, Michx. *Q. montana*, Willd. Only after visiting the Alleghany Mountains and their eastern slopes, and seeing thousands of these trees, have I fully realized the accuracy of Michaux's description in his Sylva, and have become convinced of the absolute specific difference of this tree from the other members of the Prinus group ; and, indeed, its peculiar bark and wood distinguish it from all other white-oaks. I suppose it to be the type of Linnæus's *Q. Prinus*, because it is the most common of the group in Virginia, whence the original came from: *arbor procera Virginiana*, Pluk. ; *foliis . . . . serratis denticulis rotundatis uniformibus*, Linn. H. Cliff. — The bark of the young tree before the age of 10 or 12 years is smooth and even shining, of a purplish-brown color; then it begins to crack and in the old tree becomes thick (often 1–2 inches and more) and deeply cracked and furrowed without peeling off, so that Michaux could, not inaptly, compare it with the bark of the chestnut, which, however, is darker. The wood is more porous than that of other white-oaks, and is said to be not much more useful than that of black-oaks, and unfit for barrels to hold liquids. Though its proper home seems to be in the mountain districts, it is not rarely seen in the low country eastward. Westward it is common in the mountains of Tennessee and Georgia, and has been collected on Seneca Lake in Western New York ; it is unknown in the Mississippi Valley proper. [391 (7)] — The leaves are thick, often almost coriaceous, pale below with a short and close pubescence, obovate to lanceolate, sometimes even acuminate, those of the lower branches of the tree often much wider and larger than the leaves of the upper, fertile branches ; teeth coarse and regular, obtuse, rarely larger, or occasionally almost obliterated in the sinuate margin ; the lateral nerves usually terminate above the most prominent part of the shallower teeth, and even in the sinus and only in the most prominent teeth at their apex. Fruit short-peduncled ; cup deep, somewhat turbinate, tubercled — *rough*, as the descriptions express it ; base of the scales often raised in two knobs, between which the short and almost indistinct tip of the scale next below is almost buried ; acorn large, sometimes 1–1¼ inches long and 1 inch thick.

Q. Mühlenbergii.[8] *Q. castanea*, Mühl. ap. Willd. *Q. Prinus acuminata*, Michx., occurs scatteringly throughout the middle and northern Atlantic States, in Pennsylvania only on limestone soil (*Porter*), but its proper home is the Mississippi Valley, where it entirely supplants *Q. Prinus*, more commonly on limestone hills and ridges, but also abundantly in river bottoms. Its flaky, pale ash-colored, thin bark and very tough wood (light yellowish brown when mature, whence probably the popular name of "yellow-oak") distinguish it at once from *Prinus*, as do also the small globose or commonly ovate acorns in a subsessile, shallow, and thin cup covered with small canescent, obtusish, rarely much thickened scales. Leaves on petioles ¾–1 or even 1½ inches long, thinner, more membranaceous, below pale and with an inconspicuous down, usually sharper serrate, often with inflexed teeth, and either lanceolate with a long acumination, 5–6 inches long by 1½–2 in width (the typical form of Michaux and Mühlenberg) or larger, sometimes even in fertile specimens as much as 7 inches long and 5 wide, broadly ovate or obovate with more rounded teeth, which form has often been taken for *Q. Prinus*, but is in bark and fruit identical with the narrow-leaved form.

Q. prinoides, *Willd.*, distinguished from the last by its low stature, smaller, more undulate than sharp-toothed leaves on shorter (¼–½ inch long) petioles, and commonly by deeper cups with more tumid scales, is apparently well enough marked eastward, but westward, from Western Missouri to Kansas and Nebraska, where it abundantly bears when only 1–3 or up to 30 feet high (*E. Hall, G. C. Broadhead*), it runs into the arborescent *Mühlenbergii*. It is suggested that annual prairie fires are the main cause of the stunted growth of this low form (while other species are not affected in this manner), and that often large and knobby rootstocks are found to produce numerous shoots, fertile

[8] As Mühlenberg's as well as Michaux's name for this very distinct species is preoccupied, it seems fit to commemorate the celebrated Pennsylvanian botanist's name by this oak, which he had so well distinguished.

in the first season. Prof. Gray informs me that Mühlenberg, in his manuscript *Florula Lancastriensis*, considers this form a variety of his *castanea;* he enumerates the following of the Prinus Group: *Q. castanea* [392 (8)] with *β prinoides*, *Q. Prinus*, and *Q. bicolor*.[4]

Q. DOUGLASII, *Hook.*, is the only Californian oak which might be confounded with *Q. Garryana;* but, if I understand it aright, it can always be distinguished by its small, oval, obtuse, bright brown, slightly hairy winter buds; its smaller, more sinuate than lobed leaves, which, downy in early youth, soon become glabrous on the upper side, with a bluish tinge, whence it has received locally the name of blue-oak, or blue mountain-oak. It extends not as far north as *Garryana*, probably not into Oregon, but farther south on the lower hills and mountains of the Pacific slope.

Q. UNDULATA, *Torr.* Enough has been said in the introduction to this paper and on p. 382 about the wide limits of variation which this species enjoys; local botanists, however, are not agreed as to the relations these forms bear to each other. We are safe in arranging all the varieties in two groups. The first is characterized by larger, strongly lobed, darker green and decidedly deciduous leaves, and narrower, ciliate calyx lobes; the second has smaller, paler, more rigid, mostly spinous-dentate, and — at least southward — more or less persistent leaves, and broader, woolly calyx lobes. In both groups the sweet and edible acorns are oval, oblong, or sometimes elongated; the subhemispherical, sessile, short- or sometimes long-peduncled cup varies from scaly to very knobby; in the dark-leaved forms the acorns are often thicker and shorter, in the pale group slender and longer. Distinct as both groups seem to be, the original *Q. undulata*, my var. *Jamesii*, completely connects them. Var. *Gambelii*, with broader emarginate or even lobed divisions of the large leaf, on one side runs into var. *Gunnisoni* with narrow and entire lobes, and on the other into var. *breviloba* (*Q. obtusiloba*, var. *breviloba*, Torr. Bot. Bound., and probably *Q. Durandii* and *Q. San Sabeana*, Buckley) with sinuate or broad- and short-lobed leaves. The forms of this group are found from Western Texas through parts of Colorado, Utah, New Mexico, and Arizona, but not west of the Colorado River. Var. *Jamesii* is a *Gunnisoni* with acute lobes of the smaller, more rigid leaves, found thus far only from West Texas to Colorado. The transition is almost imperceptible from this to the pale-leaved forms, which southward become evergreen, in so far as they lose their old leaves not before the new ones develop. They do not extend as far north nor east as the dark-leaved group, but farther southwestward through the California desert, and into the mountains bordering it on the west.

This pale-leaved group consists principally of var. *pungens* (*Q. pungens*, Liebm., as to sp. Wright 664; var. *Wrightii*, p. 382, which has constantly been confounded with *Q. Emoryi*) with small (1 inch or less [393 (9)] long) sinuate-dentate leaves, the teeth very rigid and pungent. Var. *grisea* (*Q. grisea*, Liebm., Wright 665 from West Texas) with oblong, more or less entire, often hoary leaves, which commonly passes for *Q. oblongifolia*, can scarcely be distinguished from *pungens*, as both forms occasionally are found on the same bush. Var. *grandifolia*, with very large (3–5 inches long) nearly entire or undulate leaves and very long peduncles, was found by Dr. Palmer in Arizona, and by Mr. Brandegee on the upper Arkansas.

Q. OBLONGIFOLIA, *Torr. Bot. Sitgr. t.* 19, not of Bot. Mex. Bound., the South California "live-oak," a bush or a middle-sized tree with pale flaky bark; oblong, obtuse, coriaceous, subpersistent leaves, at first soft downy, but soon glabrous on both sides (like those of *Q. alba*); short, oval, woolly calyx lobes, and sessile or short peduncled acorns. The leaves of young shoots are usually dentate, those of fertile trees are entire or rarely sinuate. — This species seems to come to perfection on the coast mountains and in the valleys of Southern California from San Diego to San Luis Rey and Los Angeles, but extends into Western New Mexico, where it was first discovered, and into the adjacent parts of Mexico (Chihuahua, *Dr. Gregg*).

Q. DUMOSA, *Nutt.* (see p. 382), the characteristic scrub-oak of the Californian coast ranges from San Francisco southward, is closely allied to the last and still more so to var. *pungens* of *Q. undulata*, but occupies a different geographical range, has more sinuate-dentate than spiny-toothed leaves, dark green above; calyx lobes lanceolate, acute. The cup scales are strongly tuberculate, or rarely almost even. — Coulter's 661, on which Liebmann founded his *Q. berberidifolia*, is exactly this species; but Fremont's specimens, also quoted by him, at least those in Hb. Torrey, all belong to *pungens*.

Var. *bullata*, with thicker, paler, convex leaves, persistently woolly on both sides, has been found on the Santa Lucia mountains and near New Idria by Brewer, and in Pope Valley by Bolander.

Page 383. *Q. chrysolepis* — I distinguish as a subspecies *Q. vaccinii folia*, Kellogg, a small-leaved evergreen shrub of the sierras, the oblong or lanceolate leaves, except in young shoots, entire, rarely more than 1 inch long, the yellowish

[4] The insects appear to understand the natural relations of the species of this group as well as we do; on all of them, and on no other oaks, I have noticed a very peculiar gall — for a gall I must take this excrescence to be — on the cups, singly or several together, usually surrounded by fringe-like scales, sometimes hollow, sometimes containing what looks like a diminutive acorn. Entomologists are, I suppose, well acquainted with these galls. Sometimes they have been taken for minute abortive acorns from the axils of cup scales; but cup scales are not leaf organs, and cannot well produce axillary buds.

scurf very deciduous or sometimes entirely absent. Another extreme and somewhat aberrant subspecies I name for its discoverer, *Q. Palmeri*. It is a stout and scraggy shrub, in the mountains 80 miles east of San Diego, 8–10 feet high, with very rigid and spiny, sinuate-toothed, broadly oval leaves, less than 1 inch long, scurfy on the lower side ; anthers about 10, smaller than in *chrysolepis*, emarginate, not cuspidate ; cup obconic ($\frac{3}{4}$ inch wide, $\frac{1}{2}$ inch high) ; its scales almost hidden in the dense, fulvous tomentum ; nut inside densely woolly, which I find in no other white-oak ; abortive ovules basal.

Q. TOMENTELLA, *n. sp.*, is an oak from the Island of Guadaloupe off the coast of the Californian peninsula, which I had formerly classed with *chrysolepis* (Palmer, Flor. Guad. Nos. 88 and 89), but which appears to be well distinguished by its tomentose young leaves and branchlets, which latter retain this coating for several [394 (10)] years. The full-grown leaves are short-pedicelled, ovate lanceolate acute, at base obtuse, undulate-crenate (only on young shoots spinose-dentate), glabrous above and brownish-furzy below, about 2 inches long and half as wide, and persist into the third year. Male aments tomentose, calyx lobes oval-obtuse, anthers about 10, cuspidate ; female flowers short-peduncled. Large oval acorns (16 lines long) in a shallow cup covered with dense brown wool, from which protrude the small triangular tips of the scales. Maturation of the fruit unknown, but from the close affinity to *chrysolepis*, probably biennial, though the apparently nearly allied *Q. tomentosa*, Willd., has annual fructification.

Q. EMORYI, *Torr.* (see p. 382, where l. 3 from below, "Whipple" ought to read *Wheeler*). This form, which connects the white-oaks with the black-oaks, is of the greatest interest to the student, but annoying enough to the systematic botanist. While we have several other black-oaks with annual fructification, I know of only this one with basal abortive ovules, like the white-oaks ; but the black rough bark, the wood, the small number (2–5) of large anthers, the long, recurved styles, the membranaceous brown cup scales, and the tomentose inner coating of the shell, can leave no doubt about its proper position among the black-oaks. It grows from West Texas through New Mexico to Arizona, generally as a large bush, but Dr. Palmer and the Rev. Mr. Greene have found it also a tree up to 2 feet diameter at base and 30 feet high. Its leaves are persistent through winter, but fall about the flowering-time.

Q. RUBRA, *Linn.*, so easily recognized in its typical form, is really one of the most variable of the Atlantic species, especially north and northwestwardly. All the forms have a smoothish bark with rather shallow fissures, the young leaves lose their early thick down (usually pale below and bright red above) at or soon after flowering-time, and the scales of the ordinarily very shallow, large cups are small, closely appressed, and slightly downy or almost glabrous. The lobes of the normal leaf taper almost undivided from a broad base, bearing a few coarse or small teeth ; but other forms have leaves similar to those of *coccinea*, with divaricately pinnatifid lobes, or the leaves are smaller and more deeply divided, with fewer lobes, much like those of *palustris ;* their acorns are always smaller than in the typical *rubra* and the cup rather deeper. Var. *runcinata* has narrower, lobe-dentate leaves, the large, regular teeth nearly entire. The acorns of *rubra* are between 6 and 12, usually 9 or 10 lines thick, ovoid, rarely elongated or sometimes subglobose. In northern forms the cup is apt to become more hemispherical or even turbinate, and the scales not rarely tumid at base after the manner of the white-oaks. This form I take to be *Q. ambigua*, Michx., which by others is thought to be a variety of the next species. Some oaks from northern Illinois (Bebb, Nos. 4, 5 and 7), with rather larger and looser cup-scales, and except 7, with deeply pinnatifid leaves, come near to *coccinea*, and may possibly be hybrids of *rubra* and *coccinea*.

Q. COCCINEA, *Wang.*, is readily distinguished by its turbinate cups with large, loosely imbricate (when dry almost squarrose), yellowish-gray pubescent scales, the acorns mostly ovoid-globose, retuse, or oval and [395 (11)] pointed. I have, with some hesitation, followed DeCandolle and Gray in uniting with this species *Q. tinctoria*, Bart., which has longer and more pointed buds ; broader, less lobed, and firmer leaves, paler on the under side, smaller and more pointed acorns, at least in the few fruiting specimens I have been able to examine, and a deep yellow-colored inner bark. I suspect that specific differences may yet be discovered ; for the present I venture to introduce it as a subspecies.

Q. GEORGIANA, *M. A. Curtis*, confined, as far as known, to that isolated granite rock, the Stone Mountain, east of Atlanta in Georgia, which is also the only locality for *Gymnoloma* (formerly *Rudbeckia*) *Porteri*, Gray, and for *Isoëtes melanospora*.[5] Leaves glabrous from the first, generally lance-oval, oval or sometimes obovate, mostly coarsely sinuate-

[5] *Isoëtes melanospora*, n. sp. amphibia, parvula, gregaria, plerumque monoica ; trunco placentiformi bilobo ; foliis paucis (5–10) distichis stomatosis sine fasciculis fibrosis peripherieis ; velo sporangium suborbiculare totum tegente ; macrosporiis (0.35–0.45 mm. diam.) minutissime sub lente verruculosis obscuris (humidis nigricantibus), microsporiis (0.028–0.031 mm. longis papillosis obscuris.

In shallow depressions a couple of inches deep and a few feet in diameter, on the naked granite surface near the top of the mountain, where occasional rains and dews furnish temporary and precarious moisture, but where for weeks and even months the glaring sun, flashing on the naked rock, parches and bakes them : discovered by Wm. M. Canby in May, 1869 ; revisited by Prof. Gray in April, 1875, and by Mr. Canby and myself in September, 1876, when nothing was perceptible but the dead, matted root-fibres attached to the small shrivelled corms. — Corm 3–4 lines in diameter, flat, only $\frac{1}{2}$–1 line thick ; leaves 2–2$\frac{1}{2}$ inches long, in all the specimens examined

toothed, with 2–4 teeth or lobes, rarely pinnatifid or sometimes entire or undulate ; crowded acorns small, subglobose ; shallow, flat cups, truncate or rarely rounded at base, with triangular, obtuse, nearly glabrous, appressed scales. Perhaps too near *Q. palustris*, from which the fruit is scarcely distinguishable, though the locality, the growth, and the foliage differ.

Q. LAURIFOLIA, *Michx.*, appears after all to be distinct from *Q. aquatica ;* whether entire or lobed, the leaves of the latter mostly have a cuneate outline widest in the upper third or at least above the middle ; the calyx lobes are larger and very conspicuous, and the filaments enclosed and only the anthers exsert. *Q. laurifolia* has lanceolate oblong leaves, widest about the middle whether entire or lobed ; the calyx lobes are much smaller ; filaments exsert ; this in flowering specimens of both species from Bluffton, the only ones which I could compare. A specimen from the gulf coast of Mississippi has oval entire coriaceous leaves 4 inches long and 1½ inches wide, while those of the South Carolina plants are narrower, and rather approach to *Phellos*, but never to *aquatica*. They usually persist until the budding time, but not beyond it.

Q. CINEREA, *Michx.* In specimens from South Carolina I find, together with the ordinary stellate pubescence, an abundance of yellow articulated hair on the young leaves, while in flowering Texan specimens [396 (12)] it seems to be entirely wanting.

Q. WISLIZENI, *A. DC.* With his usual acumen, A. DeCandolle discovered this species in a small fruiting specimen, brought by Dr. Wislizenus in 1851 from the American Fork of the Sacramento River, but through a mistake of mine, he located it near Chihuahua. Since then nothing further, I believe, has been published about this remarkable oak, though an abundance of material and very full notes have been gathered by different collectors, principally by Prof. W. H. Brewer and Dr. H. Bolander.

This species is found throughout the western parts of California from Shasta to San Diego, principally in the region of the foot-hills, but does not ascend the higher mountains. In some localities it makes a "magnificent tree" 40 to 60 feet high, with a trunk occasionally 6 feet in diameter, but branching 5 or 6 feet from the ground, as most of the large Californian oaks of both groups are wont to do. On the coast ranges from Monte Diablo to San Diego it also occurs as a small shrub with small leaves.

The bark is pale and smoothish in younger, very rough and black in older trees. The firm, leathery leaves persist 14 or 15 months on the branches ; they vary excessively, often on the same tree, from broad ovate to narrowly lanceolate ; cordate, obtuse, or acute at base ; the margin entire, or with a few teeth or sharply and closely dentate ; shoots or young trees have usually dentate, old and fertile ones more commonly entire leaves. In the earliest age the leaves are very slightly concave, and in vernation imbricate ; they bear on both sides articulated hairs, but soon become glabrous ; the full-grown leaves are mostly dark green and shining, and delicately reticulate, principally on the upper surface. They are usually 2–4 inches long and half as wide, or rarely narrower ; petioles 5–9 lines long ; in var. *frutescens* the leaves are only 1–1½ inches long, oval, entire, or often very sharply and deeply lobed-dentate ; petioles 1–2 lines long.

The rhachis of the aments is stellate-canescent, or nearly glabrous ; calyx lobes 5 or 6, large and broad, nearly glabrous or ciliate-bearded ; anthers 3–6, often pointed. Bracts of the sessile (or often peduncled) female flowers large, orbicular, membranaceous ; the long, recurved styles not rarely 4 or 5 in number. Acorns always elongated, 9–18 lines long, immersed ⅓ to ⅔ in the cup, which I find varying from 6–11 lines in depth and 5–6 lines in width ; cup scales elongated, acutish, light brown, and nearly glabrous.

On one hand this species approaches to *Q. agrifolia*, with which it has often been confounded, and on the other to *Q. Sonomensis*.

Dr. Kellogg, in Proc. Cal. Ac. 2, 36 (DC. Prod. 16, 2, 79), scantily describes an oak under the name of *Q. Morehus*, which may belong here.

Q. MYRTIFOLIA, *Willd.* Willdenow's description of the foliage, which cannot possibly refer to any other oak, together with his locality, makes it certain that in Dr. Mellichamp's very complete specimens we have his plant before us, and, thanks to him, I can now re-establish this little-known and often doubted species. It [397 (13)] grows on the poorest sand ridges near Bluffton, together with *Pinus australis*, very rare there, but apparently extending along the coast to Florida. It makes an evergreen shrub from 1½–2, usually 4–5, and up to 8 feet high. Leaves rounded ovate, cordate, obtuse, or sometimes acute at base, obtuse and in youth bristle-pointed at tip, revolute on the margin, thick and leathery, persisting 15–18 months. Leaves vary sometimes to broadly obovate, or are rarely,

distichous, which I have not seen in any other species ; sporangia ½–¾ line in diameter, usually emarginate above, almost black from their dark contents, but without any brown cells ; often remaining for a time attached by their base when their leaf has withered away. The plant, which I have cultivated for several years, seems to vegetate as soon as moisture is furnished, but lies dormant part of the year ; spores mature in May and June. — This species, *I. flaccida* from Florida, and *I. Nuttallii* from Oregon, are the only American *Isoëtes* in which the spore-case is entirely enclosed in and covered by the velum ; and it is the only one of ours with dark spores, all the others having white ones.

on young shoots, sinuate-angled ; they are usually 1–1½ or even 2 inches long, but on vigorous ground-shoots have been found 2½ and 3 inches in length by 2 in width. The young leaves are densely covered with a rusty, clammy scurf of articulated hair, which after a month or so disappears, leaving a glossy surface. Vernation imbricate ; youngest leaves flat with recurved margins. Aments about 1½ inches long with stellate-canescent rhachis, 5 oval pubescent calyx lobes, and a few (mostly only 2–3) small cuspidate anthers. Fruit sessile or usually short peduncled, single or in twos ; cup very shallow, about 6 lines wide, with ovate-triangular obtuse scales ; gland ovate or subglobose, 5 or 6 lines long, covered by the cup for ⅓ or ¼ of its length. — *Q. myrtifolia*, Willd., Nuttall, Pursh, Elliott, only the first two of whom seem to have seen sterile specimens ; flower and fruit had been unknown. — *Q. Phellos*, var. *arenœria*, Chapm. *Q. aquatica*, var. *myrtifolia*, A. DC.

HYBRID OAKS.

The question of hybridity in plants is in every case difficult to solve where its usual character, the sterility [6] of the hybrid, fails us, and where we have nothing to rely on but the rarity and individuality of a form that seems to stand intermediate between two well established species which occur in its neighborhood, and which could be considered its parents.

This is just the case in oaks. All the supposed hybrids are abundantly fertile, and those of their acorns which have been tested have well germinated ; in fact, as far as I know, no [398 (14)] difference in fertility or germinating power between them and the acknowledged species has been discovered. The seedlings of such questionable individuals do not seem to revert to a supposed parent, a sport of which they might be claimed to be, but propagate the individual peculiarities of the parent ; "come true," as the nurserymen express it. For how many generations this may continue, and whether in time forms approaching one or the other parent may not appear, remains to be seen. At the same time it is a remarkable fact, that, notwithstanding their fertility, they do not seem to propagate in their native woods. We may properly ascribe this to a lesser degree of vitality in the hybrid progeny, which causes them to be crowded out in the struggle for existence : one of the provisions of nature to keep the species distinct ; or, as Dr. Gray suggests, fertilization by one of the parents may soon extinguish the hybrid characters. I find ten forms, enumerated below, which I consider as real hybrids ; of them only a few, often only single individuals, have become known. Their existence cannot well, without straining facts, be considered due to innate variability in the supposed parents. When more carefully looked for, undoubtedly more will be discovered.

White-oaks and black-oaks are too distinct to be crossed.

Among the white-oaks hybrids seem to be much rarer than among the black-oaks, or it may be that they are more difficult to discover. Of the former, I have thus far been able to trace 3 forms only which I must take for hybrids, and all of them point to *Q. alba* as one of the parents.

Q. ALBA × MACROCARPA is sent by M. S. Bebb (No. 27) from Northern Illinois ; the leaf is that of *alba*, with a persisting down on the under side ; the cup is not larger than in *alba*, but a little deeper and with the prominent trian-

[6] On the muddy banks of the Mississippi near this city, where several species of *Nasturtium* (*palustre*, *obtusum*, *sessiliflorum*, and *sinuatum*) are abundant, two hybrids occur among them which will illustrate the different sexual qualities which hybrids may possess. The first, an offspring of *palustre* and *sinuatum*, is a normal hybrid with small anthers and abortive, shrivelled pollen-grains, with unimpregnable though apparently well-formed ovules, and small and absolutely sterile pods. It is perennial like *sinuatum*, and erect like *palustre*, abundant flowers of intermediate size, in long, virgate racemes, and, singularly enough, with uncommonly large stigmas. The other, a hybrid between *palustre* and *obtusum*, on the contrary, produces good pollen and is quite fertile, so that it might be questionable whether it really is a hybrid ; and indeed it has all along been considered a form of *obtusum* until Mr. Eggert pointed out its intermediate character. The true *obtusum* is always prostrate and small (branches not more than 6 inches long), has minute whitish flowers, petals only half as long as sepals, small orbicular anthers, and elongated, suberect pods on very short pedicels. *N. palustre* is erect, has large oblong anthers and shorter patulous, long-pedicelled pods. The cross occurs in all forms, from the small and prostrate to the tall and erect one, often as if struggling between an erect and a decumbent habit, with some branches in one, others in another direction ; the yellow petals are longer than in *obtusum* but much smaller than in *palustre*, anthers as in the former ; pods shorter than in *obtusum*, on longer, patulous pedicels.

gular scales of *macrocarpa*. Another specimen, much nearer *macrocarpa*, was studied by E. Hall, a number of years ago, in central Illinois (Amer. Ent. & Bot. 1870, p. 191). The leaves are those of the latter species; the bark, the down of the young leaf and inflorescence, and the acorn, more that of *alba;* while the deep cup, covering half the acorn, is that of a small-fruited *macrocarpa*, but entirely destitute of a fringe; its acorns develop much slower than those of *macrocarpa*, and more conform to *alba*. Of the allied oaks, *macrocarpa*, *alba* and *stellata*, the first develops its acorns soonest and the last latest; these last are not larger than peas by the end of August, when those of *alba* are nearly full grown.

Q. ALBA × STELLATA. A specimen from the same careful observer (Bebb, No. 24) must, I believe, [399 (15)] be referred here. Leaves similar to those of *alba*, with the narrow lobes occasionally widened forward and retuse, after the manner of *stellata*, pubescent on the under side, as well as petioles, branchlets, and shallow cups; cup scales distinct and regular but considerably tumefied at base; in *alba* these scales are almost entirely changed into very prominent knobs with short obtuse membranaceous tips; in *stellata* they are lanceolate, very distinct, only slightly tumefied, and more canescent. Bark and flowers of Mr. Bebb's tree are unknown to me.

Specimens from South Carolina, sent by Dr. Mellichamp, mentioned p. 389, seem to indicate other hybrid forms of the same parents. One has the leaves and furrowed bark of *stellata*, but the glabrous branchlets and glabrous anthers of *alba*. The other's bark is flaky like that of *alba;* the branchlets, the sinuate or obtusely-lobed leaves, and young acorns, are glabrous; anthers unknown. Of neither have I seen the fruit.

Q. ALBA × PRINUS. A single tree, now unfortunately destroyed, was observed by Dr. G. Vasey near Washington. Bark "rougher and darker than in *alba;*" leaves incised-serrate, of firm texture, glossy above, pale and slightly pubescent beneath; hemispherical cups with distinct tumid scales terminating in triangular membranaceous tips. The leaves are more those of *Prinus* than *alba*, the acorns belong rather to the latter. Both supposed parents grew with it on a gravelly hillside.

The hybrid black-oaks are much more numerous, or, to speak more correctly, more have thus far been noticed, perhaps because their leaf-forms are more various, and thus the intermediate ones are more easily recognized. The mixture of entire-leaved with lobe-leaved forms would of course be most readily discovered from the intermediate leaf-form of the illegitimate offspring; but it remains for further close examination to ascertain whether lobe-leaved species do not hybridize among themselves as well, or entire-leaved forms also mix together, producing offspring of less strikingly marked characteristics.

That we have to look for one of the parents of three of our hybrids to one and the same species, seems to correspond well with other observations, all pointing to the fact that some species of a genus are more prone to hybridize than others. This is true of *Verbena*, hybrids of which abound in this neighborhood in numerous forms as well as in a great many individuals; of most of them *V. stricta* appears to be one of the parents, perhaps because one of the most common species, or from some innate quality which makes it mix more readily with others; perhaps from a peculiar structure of the flower which may promote insect agency. Our hybrid Ver- [400 (16)] benas differ from the hybrid oaks in having almost always abortive anthers and in bearing scarcely any fertile seeds, while at the same time they are so common that evidently they are readily produced anew.

Our black-oak hybrids are the following: —

Probable Parents.		Name under which described.	Habitat.
Q. Catesbæi,	*aquatica,*	*sinuata,*	South Carolina.
Q. Catesbæi,	*laurifolia,*		South Carolina.
Q. imbricaria,	*nigra,*	*tridentata,*	Illinois.
Q. imbricaria,	*palustris,*		Missouri.
Q. imbricaria,	*coccinea,*	*Leana,*	Ohio to Missouri and near Washington.
Q. Phellos,	*coccinea,*	*heterophylla,*	N. Jersey and Delaware.
Q. ilicifolia,	*coccinea,*		Massachusetts.

Q. CATESBÆI × AQUATICA. Q. SINUATA, *Walt. Car.* 235, *DC. l. c.* 74. It is quite probable that in the tree observed by Dr. Mellichamp, several years since, near Bluffton, S. C., we meet with Walter's obscure and long ignored species. Mr. Ravenel has also observed a similar form in South Carolina, and indicated *cinerea* as one of the parents. Dr. M.'s tree grows on a sandy ridge with *Catesbæi, falcata* and *virens; aquatica* and the rarer *cinerea* are not far off.

It is 40 feet high and well grown, has a "very dark, deeply cracked bark, which is red inside like *Catesbæi*." Leaves 4, rarely 5–6 inches long, about half as wide, attenuated at base into a partially margined petiole, 3–6 lines long; leaf itself oblong to obovate, sometimes almost rhombic; sinuate with shallow obtuse lobes to divaricately dentate-lobed; lobes obtuse, or acute and bristle-pointed, dark green and shining on upper surface, paler but glabrous and with some axillary down beneath; leaves imbricative in vernation; in early youth both sides, the lower more than the upper, are covered with the rusty, articulated pubescence of *Catesbæi;* male flowers with 4 large, pointed anthers. Acorns sessile; cup hemispherical, turbinate, 8–10 lines wide, 5 or 6 high; nut oval, 8–9 lines high and 6–8 thick, $\frac{1}{3}$ or $\frac{1}{4}$ covered by the cup. The leaves of seedlings are lanceolate to obovate, spinulose-dentate or sinuate, rarely entire. In the seedlings of this plant as well as of the regular *Catesbæi* none of the fulvous glandular pubescence, which is so characteristic of the young leaf of the grown plant, is yet developed. — One of the parents is doubtless *Q. Catesbæi*, as, among other characters, this abundant rusty down proves; as the other, *aquatica, cinerea*, or *falcata* present themselves. *Falcata* is excluded by the form of its leaves; *cinerea* might be the parent, as I formerly assumed, but the usually obovate outline of the leaf, as well as the character of the acorns, seem to point rather to *aquatica*.

Q. CATESBÆI × LAURIFOLIA, a late discovery of Dr. Mellichamp, is found in the same neighborhood, [539 (17)] "in the cove with *laurifolia* and *falcata*, a tree 50 feet high, bark very much like that of the former." — Leaves lanceolate to ovate in outline, the uppermost narrower and entire, the lower wider, and generally near the middle with 1 or 2, rarely with more, divaricate or even falcate, acuminate lobes, coriaceous, strongly reticulate above, persistent through the greater part of winter, 3–4½ inches long, ¾–2 or 2½ inches wide, petioles ¼ inch long; youngest leaves imbricate in bud, slightly downy below, densely fulvous-glandular above, soon glabrate; leaves of vigorous shoots much larger and more lobed; acorn subglobose, 7–7½ lines wide, about half immersed in a hemispherical, turbinate, downy cup.

The tree and its foliage resemble *laurifolia*, but the acorns and the shallow cup of this species are quite different; the long falcate lobes of many leaves point to *falcata* or *Catesbæi* as the other parent, while the larger size of the acorn and the deep cup indicate the latter as the most probable. Notwithstanding these signs of hybridity, the probability is not excluded that we may have nothing but an abnormal form of *laurifolia* before us.

Q. IMBRICARIA × NIGRA. Q. TRIDENTATA, *Eng. in Hb.* *Q. nigra*, var. *tridentata*, DC. l. c. 64. A single tree, rather small, which was soon afterwards destroyed, was found by me, in the autumn of 1849, on the hills 6 miles east of St. Louis, in company with both supposed parents and *coccinea* and *rubra*, together with some white-oaks. Foliage as well as fruit are of such decided character that the origin of this hybrid can scarcely be doubted; the leaves are rather those of *imbricaria*, with a touch of the peculiar lobation of *nigra*, and the fruit is more like that of *nigra*. Leaves elliptical to obovate, entire or often coarsely 3-dentate at the apex, occasionally with a few teeth on the sides; 4–7 inches long, two or three wide; base rounded or acutish; upper surface dark, shining green, lower one pale, and in September not yet quite glabrate; petiole 4–10 lines long. Acorns closely sessile; the hemispherical, turbinate, canescent cup about half-enclosing the globose nut.

Q. IMBRICARIA × PALUSTRIS* was observed by me a few years ago 8 miles west of St. Louis, in a little dell where *imbricaria* abounds; *palustris, coccinea*, and *nigra*, together with some white-oaks, were near by; the tree was only 8 inches in diameter, but in full bearing. It had, unfortunately, to give way to a railroad track; but ripe fruit was obtained, which to Mr. Meehan of Germantown has furnished fine young plants, completely agreeing in character with the parent. — Leaves slightly revolute in vernation, though not as much as in *imbricaria*, pubescent, especially below, but completely denudated before the end of May. Full-grown leaves, broad-lanceolate, mostly acute at base, entire or more frequently with a few (sometimes more) coarse, triangular-lanceolate, [540 (18)] acute, bristle-pointed teeth, glabrous on both sides; about 4 inches long, 1½ wide, rarely larger; petioles 3–4 lines long; cup moderately deep, turbinate at base, 6–7 lines wide, 3–4 high; ovate, obtuse scales, canescent, with bright brown margins.

Q. IMBRICARIA × COCCINEA was first described and figured by Nuttall, about thirty years ago, under the name of *Q. Leana*, Nutt. Sylv. Contin. 1, tab. 5 bis; DC. l. c. 62. The original tree was discovered by Mr. T. G. Lea, near Cincinnati, and is still in existence; soon afterwards, Dr. S. B. Mead found another tree in Hancock Co., Illinois. My specimen, obtained from the first discoverer, has entire or sinuate or dentate or dentate-lobed leaves, 4–6 inches long and half as wide, and even in September slightly pubescent below; lobes acute and bristle-pointed or quite obtuse; base attenuated into a petiole 5–8 lines long; acorns similar to those of *coccinea*, cup shallower with obtuse scales. The leaves in Nuttall's figure have a cordate base. Dr. Mead's tree is similar to Lea's; leaves apparently more commonly entire or undulate-sinuate, 5–7 inches long and half as wide, obtusish at base on a petiole 1 inch long; the pubescence has almost disappeared on the lower side of the autumnal leaf; acorns globose, covered ⅓–½ by the canescent cup. Prof. G. C. Swallow found a similar tree in Missouri; Mr. E. L. Greene sends another specimen from

* See account of this hybrid by A. Braun, in Bot. Zeitung, 1871, 202–3; — from Sitzungsber. Gesellsch. naturf. Freunde zu Berlin, Dec. 20, 1870. — EDS.

Macon Co., Ill., rather more glabrous but otherwise similar; and Mr. L. F. Ward discovered one near Washington. — The relationship to *imbricaria* is unquestionable, and among the lobe-leaved black-oaks we must look to one of the forms of *coccinea* for the other parent, as the acorns and especially the cup and its scales indicate. I have not seen very young leaves, but doubt not but that they are, like those of the other *imbricaria*-hybrids, revolute on the edges.

Three years ago, I found in St. Clair Co., Ill., 20 miles from St. Louis, in low, fertile woods where both *rubra* and *imbricaria* form the bulk of the forest, a hybrid which I took to be an offspring of those species; growth of the tree and bark like *rubra;* leaves of the lower limbs ample, 4–8 or 9 inches long, 2–6 inches wide, obtuse or cordate, rarely acute, at base, the smaller more commonly oblong and entire, the larger ones oval or obovate, entire or sinuate, or with a few broad and shallow obtuse or triangular bristle-pointed lobes; in June still downy on the lower surface; petioles ½–1 inch long, pubescent; the nascent leaves revolute on the margins, but much less so than *imbricaria*, and white-tomentose on both surfaces. — Now, since I have obtained upper branches and ripe fruit, I am convinced that *rubra*, though growing close by, is innocent of its existence, and that *coccinea*, forests of which grow on the hills a quarter of a mile off, must be one of the parents; in short, that it is a form of *Leana* itself. The cup of the acorn is, to me, decisive; it is turbinate, covered with rather large canescent scales, squarrose at tip, and very different from those of either *rubra* or *imbricaria*, but approaching those of *coccinea*. The globose acorn, 7 lines in diameter, one-third covered by the cup, shows 22–25 black stripes, so common in many black-oaks. The leaves of the fertile branches are cordate or obtuse at base, and almost all deeply runcinate-serrate. — This [541 (19)] instance ought to make us very careful not too hastily to judge of the parents of a hybrid from the species growing nearest to it.

Q. PHELLOS × COCCINEA, Q. HETEROPHYLLA, *Michx.*, is distinguished by the petioled leaves of lanceolate outline, entire, sinuate, spinulose-dentate, coarsely serrate, or with simple, sometimes spreading or falcate, lobes; leaves of different form on the same tree and often on the same branch, the uppermost leaves usually entire;[7] or some trees more with entire, others more with dentate or with lobed leaves. Youngest leaves strongly revolute, pubescent above, white-downy below; becoming glabrous in summer. Acorns subglobose to oval, 5–7 lines long, a little less wide, scarcely half immersed in the shallow-hemispherical, somewhat turbinate, canescent cups; scales lanceolate, obtuse. Fruit of same size and very similar to that of *falcata*, but cup usually deeper and with larger scales.

The typical specimen described by Michaux, found by him "in a field belonging to Mr. Bartram near Philadelphia," has long since been destroyed, but its offspring was introduced into Europe, and the trees now seen in Bartram's garden in West Philadelphia, at Marshall's place in Marshalltown, and in J. Hoopes's garden in Westchester, as well as those of the European gardens at Verrière, Herrnhausen, and Prague, the latter fertile, are believed to be its seedlings. Only within the last ten or fifteen years the tree has been re-discovered, and now numbers of individuals are known in low woods on both sides of the Delaware below Philadelphia (6 miles east of Camden, *Smith, Leidy, Burk, Martindale*, and 2 miles west of Wilmington, *Commons, Canby*), often in groups together, probably the offspring of some few original hybrid trees.

A. De Candolle and others viewed this hybrid as a form of *aquatica*, others, as belonging to *Phellos*, while I was long inclined to follow Michaux in considering it as a distinct species. With *aquatica*, which does not grow within a hundred miles, it has no relationship; aside from other characters, the revolute vernation abundantly distinguishes it from that species; from *Phellos* it differs in the form and size of the leaves and their thick down in youth (in *Phellos* even the youngest leaves are almost glabrous), and in the larger acorn in a deeper cup bearing much larger and longer scales. That it is a hybrid is most probable on account of its great rarity and its so very variable foliage. One of its parents is undoubtedly *Phellos;* for the other we must look among the lobe-leaved black-oaks of its neighborhood, *falcata*, *rubra*, or *coccinea*. While the sometimes falcate lobes of the hybrid and the similarity of its acorns point to the first, and its frequency in those localities to the second, we find the texture of the leaf and its reticulation, as well as size and form of the cup and its scales, intermediate between *Phellos* and *tinctoria*, and quite different from the other two species, and thus come to the conclusion that the former must be the parents. [542 (20)]

Q. ILICIFOLIA × COCCINEA, *Robbins in Gray, Man. ed.* 5, *p.* 454, discovered by Dr. Robbins at Uxbridge, Massachusetts, in 1855, of which I have seen flowering and fruiting specimens in the Cambridge Herbarium, seems just intermediate between the two parents. "Tree 40 feet high, 19 inches in circumference, both parents within 4 rods"; leaves 4-5½ inches long, nearly 4 wide, sinuate-lobed, lobes acutate, mostly bristled-toothed toward their apex; youngest ones greenish pubescent above, canescent below, at maturity strongly reticulate (*ilicifolia* is very slightly so) and shining above, and with the branchlets lightly pubescent below; cup deeper than in *ilicifolia*, glabrate. The persistent though light pubescence resembles *ilicifolia*, while the shape of the leaf reminds one of *rubra* rather than *coccinea*.

[7] This is the case generally in heterophyllous hybrids, i.e. hybrids between entire-leaved and lobe-leaved species; the uppermost leaves of an axis are apt to be entire, while the middle ones are lobed, etc.; thus the lower branches also often bear entire leaves, while the upper ones have more lobed ones.

Several forms of oaks have at one time or another been considered as hybrids which most probably are varieties or sports of one or the other of the well-established species.

Q. OLIVÆFORMIS, *Michx.*, is a variety of *macrocarpa* with elongated acorns in a deep and narrow cup, and not a hybrid of *macrocarpa* with *alba*, as has been suggested.

Q. RUNCINATA* was the name given to a form I found in the richest Mississippi bottom-lands opposite St. Louis, together with *rubra*, *imbricaria*, and *palustris*. From its smaller and narrower, coarsely dentate, not lobed leaves, and its smaller fruit, it seemed distinct enough from *rubra*, and was possibly a hybrid of it and some other small-fruited allied oak. But the leaves of *rubra* are so variable in size and outline that DeCandolle (l. c. 60) was right in considering it a variety of *rubra*.

Q. FALCATA., var. *subintegra*, is a variety of *falcata* which I had taken for a hybrid of that species and *cinerea*. Dr. Mellichamp sent it from South Carolina and Mr. Canby from Maryland. It seems to be only a strange sport of *falcata* itself, an extreme state of var. *triloba*, with trilobed as well as entire leaves. The glandular pubescence of the young and the smoothish, not reticulated, upper surface of the mature leaf are those of the species. Fruit not seen.

Q. QUINQUELOBA I named a form of *nigra* with 5-lobed leaves, which I found on the hills of St. Louis, and at one time considered as a cross between *nigra* and *tinctoria;* DeCandolle (l. c. 64) places it correctly with *nigra*. It is not even a variety, but rather a juvenile state which had become permanent in that tree; [543 (21)] young trees or shoots of *nigra* have sinuate-dentate or many-lobed leaves, but in fertile ones the leaves are almost always more or less 3-lobed or 3-dentate at the much-widened apex. I have since seen a tree which on one fruit-bearing branch had only the leaves of *quinqueloba*, while all the other branches had the regular cuneate 3-dentate *nigra* leaves. The same form occurs near Washington (*L. F. Ward*, in "Field and Forest," October, 1875, where several other real or supposed hybrids are enumerated, which call for further careful investigation *in loco*).

New material having come to hand since the above was in type, I have to add some further remarks.

The typical *Q. palustris* has globose or depressed acorns, but near St. Louis it is occasionally seen with oblong or even elongated acorns. A specimen of *Q. Texana*,† Buckley, sent by the author to the Agricultural Department, Washington, is evidently this form of *palustris*, though it is said to grow near Austin "on hills."

Page 394. Another abnormal type, which I cannot but refer to *rubra*, has been sent from the bottom lands of the Comale and Blanco rivers, affluents of the Guadalupe, Texas, by Lindheimer and Wright. The leaves have the cut of *coccinea;* the large (1 inch long by less than ⅔ wide) oblong acorns are borne in hemispherical slightly turbinate cups, covered by small appressed, smoothish scales. The bark of the tree is "pale and smoothish, much like that of *aquatica*." In many respects the tree seems to be intermediate between *rubra* and *coccinea*, an "ambiguous" form.

Q. COCCINEA: numerous specimens, fresh ones from this neighborhood, and dried ones with mature fruit from different localities, have weakened my hope of distinguishing *tinctoria* from the typical *coccinea*. The yellowish-canescent, squarrose cup-scales are found in all the forms of this region, but northward as well as eastward they do not seem to be so characteristic of the species; there they are often smaller, more appressed, and less canescent; and this may be the form which Michaux has figured as his *coccinea*, while his *tinctoria* has larger and paler scales. We may, then, distinguish the following varieties: 1. Large winter buds, leaves with broader undivided lobes, cup-scales squarrose, acorns oblong or globose. 2. Small winter buds; leaves with slender, deeply cut, divaricate lobes, cup-scales and acorns as in 1. 3. Buds and leaves as in 2; cup-scales smaller, more glabrate, appressed; acorns more commonly ovoid. The first may be Bartram's *Q. tinctoria*, the third the true *coccinea*, and the second an intermediate form. The third variety closely approaches what I have considered as the form *ambigua* of *Q. rubra*.

The Oaks of Wheeler's Expedition (Report, Botany, 1878, pp. 249–251), and of the Botany of California, 1880, II. 93–99, are by Engelmann, but no new species are included.

In the former paper (p. 251), it is said of *Q. Emoryi*, Torrey: "Botanically a most interesting species, as it combines many characters of the white-oaks, viz, the annual maturation and especially the position of the abortive ovules at the base of the nut, with characters of the black-oaks, viz., the black bark and coarse wood, the small number and large size of the stamens, the long, recurved styles, and the tomentose inner coating of the shell; the leaves show, as they do in many black-oaks, a stronger reticulation on the upper than on the lower side." In the latter publication (p. 97) *Q. chrysolepis*, var. *Palmeri*, Engelm., is raised to specific rank, under the name *Q. Palmeri*, Engelm. — EDS.

* Gray's Manual, 5 ed., 1868, p. 454. — EDS.

† In a note in the Botanical Gazette, 1882, vii. 14, Dr. Engelmann subsequently states that "Buckley's *Quercus Texana* is undoubtedly correctly placed by him with the polymorphous *Q. rubra*." — EDS.

II. VEGETATION ALONG THE LAKES.

From the Transactions of the St. Louis Academy of Science, Vol. IV. 1880, Proceedings. [Read in 1878.]

The country is partly flat, partly rolling, and is covered in many places with dense woods, [xx] mostly of coniferous or of deciduous soft-wood trees. Among them the "gray-oak of Canada" occurs, described by Michaux as *Quercus borealis*, or *Q. ambigua*, our most northern oak, found from Lake Superior to Lower Canada and to Nova Scotia. Its acorns and leaves cannot be distinguished from those of our red-oak, *Q. rubra*, L., of which it is without doubt a northern variety with paler bark and tougher wood. It grows to be a large tree of over two feet in diameter, and its wood is highly esteemed in those regions. I cannot make much of the figure of the acorn of *Q. ambigua* in Michaux's Sylva; it does not resemble any form of gray-oak acorns I have seen. Can it belong to the following?

The other oak of the shores of Lake Superior is a kind of black-oak, a smaller and, up there, much rarer tree, but which becomes much more common farther south, on dry land in Minnesota and Wisconsin, and seems to extend eastwardly to the New England States. Farther south it gives way to the ordinary black-oak (*Q. tinctoria! Q. coccinea?*) which, though very variable in foliage, is always characterized by the large, thin, somewhat squarrose-tipped cup-scales: the black-oak of the Middle States. In Northern Illinois both are found. The northern black-oak has a very rough black bark; leaves coarsely, or often very finely lobed (as to resemble the foliage of *Q. palustris*); a turbinate cup with small, appressed, and more or less tumid scales, so that the cup appears tuberculated almost like that of a white-oak. The most common white-oak of Minnesota is *Q. macrocarpa*, popularly known under the name of burr-oak.

A few plants otherwise peculiar to the Atlantic shores also occur along the northern lakes, which is explained on the hypothesis that these shores were once sea-coasts.

III. THE ACORNS AND THEIR GERMINATION.

From the Transactions of the Academy of Science of St. Louis, Vol. IV. 1880.

The structure of the acorns and the germination of the oaks seemed to be so well [190 (1)] known, that I did not pay much further attention to it until my interest was excited by the information that the germinating live-oak developed little tubers, well known to the negro children, and greedily eaten by them. The notes and the specimens obtained from my South Carolina correspondents, Messrs. H. W. Ravenel, W. St. J. Mazyck (who was the first to notice this), and Dr. J. H. Mellichamp, enabled me to examine the germinating live-oak and to compare it with other oaks in this condition. I now studied the acorns, as many mature ones as I could find in my collection, and the oak seedlings which I had, as well as other seedling trees, carefully collected whenever I could obtain them. The following are the results.

In the tip of each acorn we distinguish, imbedded between the two large fleshy cotyledons, first, the little caulicle, and then at its upper end (toward the centre of the acorn) the two stalks or petioles of these cotyledons; between these the plumule is visible, more or less developed, usually only a truncate or slightly notched or emarginate knob. These parts together are in the different species and in different sized acorns usually from one to three lines long and one-half to one line in diameter; in very small acorns sometimes smaller.

The proportion of the caulicle to the stalks appears to be constant in the same species, as I have satisfied myself by examination of numerous acorns of the same species from widely separated localities.

In all the black-oaks which I could study the caulicle is longer than the stalks. [191 (2)] Thus in *Quercus nigra, imbricaria, pumila,* and *Kelloggii* I find it twice as long; in *Q. coccinea* and *tinctoria, rubra, ilicifolia,* and *agrifolia,* it is three to four times as long. *Q. densiflora,* of the section *Androgyne,* is similar in this respect to the first.

A few white-oaks resemble the black-oaks in the proportion of these parts. These are *Q. macrocarpa* and *undulata,*[1] and especially *Q. Robur* of Europe. In this and in the Californian *Q. chrysolepis* I find the caulicle nearly three times longer than the stalks; in both of them I also notice the plumule unusually developed.

But in the majority of white-oaks the caulicle is shorter than the stalks of the cotyledons; I have seen it in the American *Q. alba, stellata, Garryana, Douglasii, Breweri, Prinus, Mühlenbergii, prinoides, Michauxii, bicolor, dumosa, pungens,*[1] and in *Q. occidentalis* of southwestern Europe. It is very interesting to find that in the hybrids of *Q. macrocarpa* and *alba,* which externally resemble more the former than the latter, the proportion of the stalks and the caulicle is entirely that of the latter and not of the former. I have observed this fact in hybrids from Illinois (*Hall*) as well as from Vermont (*Pringle*).

By far the longest stalks or petioles, however, are found in *Q. virens;* in this species not only the cotyledons, as is well known, but also their stalks, are coalescent: the caulicle itself is very short, only about one-fourth or one-fifth the length of the stalks, and the place where they separate from the caulicle is indicated by the very small and imperfect plumule, completely imbedded within the connate base of the stalks.

The acorns of all oaks germinate in or on the ground, the thickened stalks and the caulicle elongate; the former become 2 to 4 or nearly as much as 6 lines long, while the cotyledons themselves remain enclosed in the cracked seedshell, and from between the bases of the stalks the plumule grows up into the ascending axis, nourished by the food contained in the cotyledons; these become exhausted and rot away about the end of the first season, while the radicle about the same time swells up, evidently absorbing part of the matter contained in them, and thus laying up a store of food for the next season. [192 (3)]

The process in *Q. virens* is essentially the same; it differs somewhat in that the connate stalk of the cotyledons remains more slender, but elongates more, mostly to the extent of one inch or even more; the caulicle and upper part of the root swells up at once, while the developing plumule forces its way up through a slit in the base of the stalk. It seems that the danger of losing connection with the storehouse of the cotyledonous mass through the long and slender passage of the stalk, necessitates the transfer of the food-matter to a nearer and safer place of deposit. But why, it may be asked, is the connection so much longer and more slender than in other oaks? At all events it suffices, as long as it is fresh and unimpaired, to carry over in a very short time the starchy and sweet contents from the cotyledons to the tuber; and before the ascending axis is an inch high and bears as yet only a few minute bracts, the tuber is already forming and it soon reaches the size of the cotyledons themselves; it is, however, longer and more slender, of a fusiform shape, about three to four lines thick and one to two inches long, attenuated below into the long tap-root.

[1] All Colorado forms of *Q. undulata* which I have examined, those with large and deciduous leaves, vars. *Gambelii, Gunnisoni, Jamesii,* as well as the small- and spiny-leaved form from the edge of the cañon of the Arkansas, which I had considered as identical with *Q. pungens,* have short stalks, while the pale and usually persistent-leaved forms from Arizona, the true *Q. pungens* of Liebmann, have the stalks longer than the caulicle. Finding the proportions of these parts to be constant and as indicating specific difference, I am now inclined to consider *Q. pungens,* including *Q. grisea,* as a distinct species, provided other characters can be found to confirm this view. In a few acorns of this form I have seen the cotyledons adhering together, but in the majority they were free.

The whole process is similar to the germination of the cucurbitaceous *Megarrhiza* of California, so beautifully illustrated by Gray in his Structural Botany; with this difference, that the cotyledons in that plant are raised above the ground,* while in ours they remain hypogæous, and that the stalk is even longer, and is, together with the cotyledons, readily separable into its two component parts. In both plants a tuber forms at once by the transfer of the food-matter from the cotyledons to the radicle; in the herbaceous *Megarrhiza* the tuber becomes a permanent organ of immense size, while in the arboreous live-oak it is finally merged in the root.

IV. DESCRIPTION OF SEPTORIA QUERCI.

From the Transactions of the St. Louis Academy of Science, Vol. III. 1878, Proceedings. [Read in 1876.]

I present to you another Fungus, on oak-leaves, which show the same yellow decayed spots; but here [ccxvi] you have to look for the perithecium, the fruit, if we may call it so, of the fungus, to the lower side of the leaf, and it is not a black globule as in the grape-leaf, but a brown elevation, little darker than the surrounding spot. I find no pore at the top, but suppose that it emits its spores through a rent. These are very different from the spores of the *Depazea* [*Labruscæ*],† being elongated, usually curved and septate, or forming three or four compartments; the spores are a little longer tnan those of the grape-spots, the perithecium is twice as large as that of the grape.

The septate spores indicate that it belongs to the genus *Septoria*, and the fungus may bear the name of *Septoria Querci*.

* But only exceptionally. — Eds.

† The remainder of this note will be found below under "Diseases of the Grape."— Eds.

IX.

PAPERS ON VITIS.

I. NOTES ON THE GRAPE-VINES OF MISSOURI.

From the Transactions of the St. Louis Academy of Science, Vol. I. 1860.

In the Transactions of the Academy (p. 156 of this volume) Prof. Swallow has published [660] an interesting contribution on the adaptation of our State to the cultivation of the grape-vine. The article, abounding in valuable information, contains some inaccuracies, which, as the whole subject is so very interesting and important, it may not be improper here to indicate.

The grape-vines proper (gen. *Vitis*, sect. *Vitis*) indigenous to Missouri are *Vitis æstivalis* and *Vitis cordifolia*, with their numberless varieties; popularly speaking, they are distinguished as the *Summer Grape* and the *Winter* or *Frost Grape*, also sometimes called *Fox Grape*. The former grows on uplands in open woods and thickets, is of smaller dimensions, has deeply lobed leaves with rounded sinuses of the lobes, covered when young with a rose-red down, more or less naked above when old, and bears smaller bunches of larger berries, ripening and edible earlier, say in August and September, whence the name.

The winter-grape, *Vitis cordifolia*, grows in richer soil, usually in shady woods, on our river banks and in [661] their bottoms, attaining the greatest dimensions (sometimes 10 inches in thickness and 80 or more feet in height); it has undivided or (with us) usually slightly lobed leaves with sharp sinuses between the lobes, entirely naked even when young or covered with a slight whitish down, and bears smaller berries in larger bunches, ripening and edible not before October or even November. Those that have experimented on them contend that, notwithstanding this, the wine made of this winter grape is by far superior to that made of the summer grape.

Both these species are extremely variable, and it is quite probable that, being dicœcious,[1] they by hybridization produce intermediate forms, which may become of interest to the cultivator, and may indicate the method by which to produce valuable new varieties.[2]

These are the principal if not the only species of *Vitis* proper, in our State, and they grow in all its counties as well as throughout the Mississippi valley. They are comprised in Prof Swallow's enumeration under numbers 1 to 4, pp. 160–161. His No. 1, *V. Labrusca*, is not the plant which Linnæus has designated by this name and which to eastern botanists is known as such. This, the true *Vitis Labrusca*, is a plant with rusty woolly leaves (naked above when old), bearing very large pulpy berries of a foxy taste, whence the popular name of fox grape in the eastern States. It is found, as far as I am informed, all along the Atlantic slope and up into the Alleghany Mountains, but does not extend into the Mississippi valley. It is considered to be the mother plant of the cultivated Catawba, Isabella, and other American varieties.

[1] It is an interesting fact that all the true grapes of America (not those belonging to the section *Cissus*), in the wild state, are dicœcious or dicœcio-polygamous, while the cultivated varieties bear complete flowers. The same is the case with the grape-vine of the Old World, which still grows wild and to an immense size in the marshy forests of the lower Arno in Tuscany, being called there to this day by the old Latin name, mentioned by Virgil, *Labrusca*, a name which Linnæus has improperly applied to one of the American species.

[2] It is well known and sufficiently proven by a thousand times repeated experiments, instituted with almost every variety of this plant from all parts of the Old World, that the *Vitis vinifera*, the grape-vine of Europe, will not thrive in our climate. Soon losing its leaves under our burning summer sun, it is scarcely able to ripen the few bunches of fruit it may bear, and cannot bring its wood to perfection; so that our variable winters almost always kill the vines down to the ground, if not carefully protected. Would it not be possible by hybridization to produce a grape-vine with the tough and enduring leaves of our native grapes and the luscious and juicy fruit of the better varieties of *Vitis vinifera*?

1. *Vitis Labrusca* of Prof. Swallow must be referred to *V. cordifolia*, when he describes it as a plant growing to very large size in our alluvial bottoms. The vines of smaller size on our dry ridges, which produce larger [662] grapes with more juicy and palatable pulp, undoubtedly belong to *V. æstivalis*.

2. *Vitis æstivalis* of Prof. Swallow, "the largest of all our vines," "with stems like huge cables," cannot be anything but the same *Vitis cordifolia;* while the variety "of the limestone ridges," etc., probably has to be referred to the true *V. æstivalis*.

3. *Vitis cordifolia* is erroneously considered a smaller plant than those enumerated under 2 and 3. The true *V. cordifolia* and its variety, 4. *V. riparia*, which forms complete transitions into the former, are by far the largest American grape-vines.

5. *Vitis vulpina*, Linn., differs essentially from all the other grape-vines by its smooth bark, which is never shaly, like that of all others. It bears very large berries in very small clusters, and is known in the South as *Fox Grape* (whence the Linnæan name), *Muscadine* or *Bullet Grape*. I have seen it abundantly in Arkansas, but never in Southern Missouri, though it may extend so far northward. Possibly it has been confounded with a species of grape which in Southern and Southwestern Missouri and in Western Arkansas and the adjoining Indian country is common on the gravelly banks of the smaller streams, which are overflowed during freshets. My specimens of this plant are not complete enough to class it with perfect confidence, but they indicate a close alliance and probably identity with *Vitis rupestris*, Scheele, of Western Texas, characterized by a low, bushy, rarely climbing stem; small, roundish, glabrous leaves, coarsely dentate, almost truncate, or with a broad sinus at base; by middle-sized berries, in small bunches of pleasant taste. It has much the growth and appearance of the muscadine, but can always be distinguished by the shaly bark of the stem and the lighter colored leaves.

The wild muscadine grape as well as its cultivated variety, the Scuppernong, has been grown in gardens about St. Louis, but has never, I believe, borne fruit, showing that our climate does not suit it.

6. *Vitis bipinnata*, Torrey & Gray, and 7, *Vitis indivisa*, Willd., cannot come into consideration in a review of our native grape-vines, which considers only their economical value, as they do not bear edible fruit. They belong to the section *Cissus* (gen. *Cissus*, Linn.) together with *Vitis incisa*, Nutt., which is found from Florida to Texas. *Vitis indivisa* is common throughout the State, especially in the valleys of our larger rivers. *Vitis bipinnata* is a southern species, and was not observed by me north of Arkansas, though it may occur in the southern parts of the State.

II. THE NORTH AMERICAN GRAPES.

From the American Naturalist, Vol. II. August, 1868.

Perhaps the first plant noticed on the continent of North America, even before Columbus [320] and before the Pilgrims, — a plant identified with the discovery of America itself, — was the grape-vine; it gave to the country the name *Vineland*, and later, to a part of it, that of *Martha's Vineyard*. And yet the grape-vines, many forms of which grow from Canada to the Rio Grande, and from Virginia to California, are among the least thoroughly known plants of North America. Linnæus knew two species; and that sagacious observer, the founder of the flora of North America, Michaux, added three more. These five species are acknowledged to this day as the principal forms found in the regions between the Atlantic and the Mississippi. But even in their native haunts they vary to such a degree, that both scientific and non-scientific observers have never felt satisfied about them. Rafinesque, about fifty years ago, undertook to describe and classify these forms; but, with his loose observation and lax scientific conscience, he, as usual, instead of becoming a guide, created inextricable confusion. Le Conte, long after him, did little to unravel the entanglement; and since their efforts to distinguish imaginary species, the tendency has rather been to combine what were formerly considered, even by conscientious authors, as distinct species.

I have long devoted much attention to the grape-vines of my home (St. Louis), but have become satisfied that no satisfactory solution can be obtained without the co-operation of the friends of botany throughout the whole country; so I ask, from their love and zeal for our science, and from the general interest which this particular investigation now commands, their friendly co-operation.

In order to arrive at satisfactory conclusions, it is necessary to study all the forms which present themselves, in all their bearings, and under the different conditions in which they are [321] found. Specimens ought to be collected in flower, exhibiting also the young shoots and developing leaves, and, *from the same stock*, in fruit, if fruit they bear; and ripe seed should be obtained; the soil, the locality, the accompanying plants, and the size of the vine ought to be noted; the difference in shape and size of the leaves of young shoots and of bearing branches is often important; the exact time of flowering, and the period of maturity, are interesting data. The size, color, and taste of the fruit; the presence or absence of the bloom on the ripe berry; the usual number of seeds in each; the conditions and color of the pulp, — all are points not to be neglected. It is not expected that species can be founded on the variations in all these characters, but it is important that the limits of variation of the different species should be defined; and that can only be done by exact study of as many forms as possible in all their bearings. Thus far I have only seen vines with perfect and with staminate flowers; purely pistillate ones may perhaps be discovered by acute observers.

The species now known to botanists in the territory of the United States, but several of them not sufficiently defined, are the following: —

I. Grape-vines with large Berries.

1. Vitis vulpina, *Linn.*, the southern fox-grape, or Muscadine, with several cultivated varieties, such as the Scuppernong, etc.

2. Vitis Labrusca, *Linn.*, the northeastern fox-grape, with numerous cultivated varieties, such as the Catawba, Isabella, Concord, Hartford Prolific, etc.

3. Vitis candicans, *Engelm.*, the mustang grape of Texas.

II. Grape-vines with smaller Berries.

4. Vitis Caribæa, *DC.*, of Southern Florida and the West Indies.

5. Vitis Californica, *Benth.*, confined to California.

6. Vitis æstivalis, *Michx.*, the summer grape of the Middle and the Southern States, with numerous varieties, of which var. *monticola* (*V. monticola*, Buckley) of Texas approaches No. 5, and var. *canescens* of the Mississippi Valley approaches No. 7; several cultivated varieties, such as Norton's Virginia Seedling, and the Cynthiana grape, are among our best wine-grapes.

7. Vitis cordifolia, *Michx.*, the sour winter or chicken-grape of the Eastern States, and its variety *fœtida* of the Mississippi Valley, often 4–6 inches in diameter, climbing the highest trees, and bearing fetidly aromatic berries. No variety, I believe, in cultivation.

8. Vitis riparia, *Michx.*, the river-bank grape, throughout the United States to the Mississippi; the only grape in East Canada, where it extends sixty miles north of Quebec (Brunet); a valuable grape in cultivation, under the name of Clinton, Taylor, and Delaware grapes. An early native variety ripens its sweet berries early in July about St. Louis.

9. Vitis Arizonica, *n. sp.*, and as yet doubtful plant, of Arizona, with small leaves and middle-sized berries.

10. Vitis rupestris, *Scheele*, the bush-grape, or (in Missouri) sand-grape, which extends from Missouri to Texas.

It is worth noting that all those of the forms enumerated above, which I had an opportunity of raising from seed, exhibit marked differences already in the seedling plant a few months old. During my absence in Europe for the next twelve months, Professor A. Gray, of Cambridge, has kindly offered his assistance in communicating with those who wish to assist me, and letters directed to me, at St. Louis, Missouri, will be forwarded to me.

III. THE TRUE GRAPE-VINES OF THE UNITED STATES.*

From the Bushberg Catalogue, 3d ed., St. Louis, 1883.

The grape-vines[1] are among the most variable plants, even in their wild state, in which [9 (3)] climate, soil, shade, humidity, and perhaps natural hybridization, have originated such a multiplicity and such an intermixture of forms, that it is often difficult to recognize the original types and to refer the different given forms to their proper alliances. Only by carefully studying a large number of forms from all parts of the country, in their peculiar mode of growth and especially their fructification, or rather their seeds, are we enabled to arrive at anything like a satisfactory disposition of these plants. (Table of grape seeds; figs. 1–33, page 13.)

Before I proceed to the classification of our grape-vines, I deem it necessary to make a few preliminary remarks: —

The grape-vines cultivated in that part of the United States lying east of the Rocky Mountains are all natives of the country, most of them picked up in the woods; some, perhaps, improved by cultivation; and a few the product of natural or artificial hybridization. In that part of the country the wine grapes of the Old World can only be cultivated under glass; but in New Mexico and California they have been successfully introduced by the Spaniards, and in the latter State a great many varieties are now extensively cultivated, and promise to make one of the great staples of that region; but eastward and northward they have entirely failed, owing to the destructive effects of that now so well known and dreaded insect, the Phylloxera, of which more further on.

All the true grape-vines bear fertile flowers on one stock, and sterile flowers on another separate stock, and are, therefore, called *polygamous*, or, not quite correctly, *diœcious*. The sterile plants do bear male flowers with abortive pistils, so that while they never produce fruit themselves, they may assist in fertilizing the others; the fertile flowers however, are hermaphrodites, containing both organs, — stamens and pistils, — and are capable of ripening fruit without the assistance of the male plants.[2] Real female flowers, without any stamens, do not seem ever to have been observed. Both forms, the male and hermaphrodite, or in other words those with sterile and those with complete flowers, are found mixed in the native localities of the wild plants, but of course, only the fertile plants have been selected for cultivation, and thus it happens that to the cultivator only these are known; and as the grape-vine of the Old World has been in cultivation for thousands of years, it has resulted

* This paper is an elaboration of synopses of American grape-vines by Engelmann, which appeared in Riley's Fourth Report of the State Entomologist of Missouri, 1872, pp. 60–62; The American Naturalist, 1872, vi. pp. 539–542; Riley's Sixth Report, 1874, pp. 70–76; and the second edition of the Bushberg Catalogue, 1875, pp. 4–11. A French translation of the Bushberg Catalogue, by Bazille and Planchon (Paris and Montpellier, 1876) includes this paper, p. 11 *et seq.*, with figures 1–18 of seeds. — Eds.

[1] We treat here only of the *true* grape-vines, with edible berries. In the flowers of these the small green petals do not expand, but cohere at the top, and separating from their base, fall away together as a little five-lobed hood. The flowers, and consequently the fruit, are arranged in the well-known clusters (thyrsus). Thus they are distinguished from the *false* grape-vines (botanically known as *Ampelopsis* and *Cissus*), which often resemble the true grape-vines very much, but bear no edible berries. Their flowers expand regularly, opening at top, and are arranged in broad, flat-topped clusters (corymbs).

[2] These fertile plants, however, are of two kinds; some are *perfect hermaphrodites*, with long and straight stamens around the pistil; the others bear smaller stamens, shorter than the pistil, which soon bend downward and curve under it; these may be called *imperfect hermaphrodites*, approaching females, and they do not seem to be as fruitful as the perfect hermaphrodites, unless otherwise fertilized.

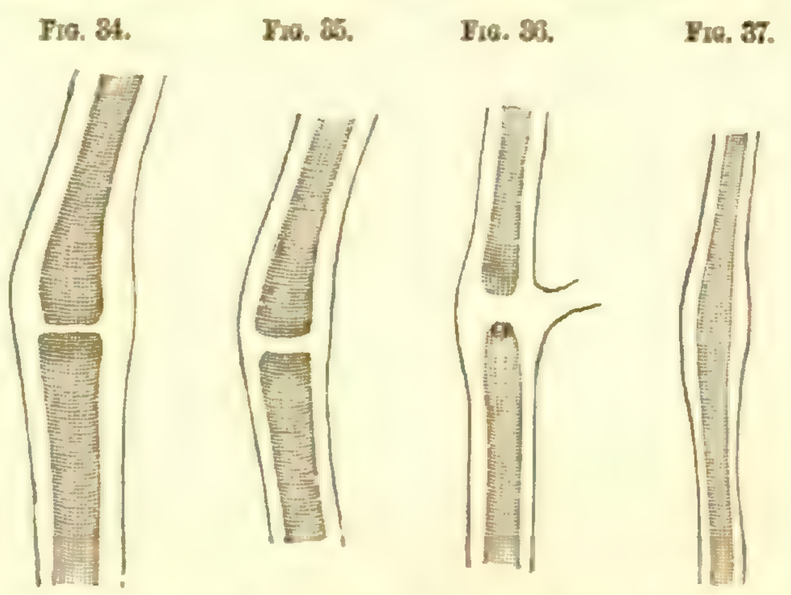
It is proper here, to insist on the fact that nature has not produced the male plants without a definite object; and this object, without any doubt, is found in the more perfect fertilization of the hermaphrodite flowers, as it is a well-established fact that such cross fertilization produces more abundant and healthier fruit. Vine-growers might take a hint from these observations, and plant a few male stocks in their vineyards, say 1 to 40 or 50 of their fertile stocks, and might expect from such a course healthier fruit, which would probably resist rot and other diseases better than fruit grown in the ordinary way. I would expect such beneficial influence especially in all varieties that have short stamens, such as the Taylor. Male stocks can be easily obtained, either in the woods or from seeds. It is of course understood that the males ought to belong to the same species (or better to the same variety) as the fertile plants to be benefited by their pollen. European vine-growers may *also* profit by this suggestion.

that this hermaphrodite character of its flowers has been mistaken for a botanical peculiarity, by which it was to be distinguished, not only from our American grape-vines, but also from the wild grapes of the Old World. But plants raised from the seeds of this, as well as of any other true grape-vine, generally furnish as many sterile as fertile specimens, while those propagated by layering or by cuttings, of course, only continue the individual character of the mother-plant or stock.[3]

The peculiar disposition of the tendrils in the grape-vines furnishes an important characteristic for the distinction of one of our most commonly cultivated species, *Vitis Labrusca*, its wild and its cultivated varieties, from all others. In this species — and it is the only true *Vitis* exhibiting it — the tendrils (or their equivalent, an inflorescence) are found opposite *each* leaf, and this arrangement I designate as *continuous tendrils*. All the other species known to me exhibit a regular alternation of two leaves, each having a tendril opposite it, with a third leaf without such a tendril, and this arrangement may be named *intermittent tendrils*.* Like all vegetable characters, this is not an absolute one; to observe it well it is necessary to examine well-grown canes, and neither sprouts of extraordinary vigor, nor stunted autumnal branchlets. The few lowest leaves of [10 (4)] a cane have no opposite tendrils, but after the second or third leaf the regularity in the arrangement of the tendrils, as above described, rarely fails to occur. In weak branches we sometimes find tendrils irregularly placed opposite leaves, or sometimes none at all.

It is a remarkable fact, connected with this law of vegetation, that most grape-vines bear only two inflorescences (consequently two bunches of grapes) upon the same cane, while in the forms belonging to *Labrusca* there are often three, and sometimes, in vigorous shoots, four or five, or rarely even more in succession, each opposite a leaf. Whenever in other species, in rare cases, a third or fourth inflorescence occurs, there will always be found a barren leaf (without an opposite inflorescence) between the second and third bunches.

Another valuable character, discovered by Prof. Millardet, of Bordeaux, is found in the structure of the branches ("canes," as they are usually called). These contain a large pith, and this pith is transversely separated at each node (point where a leaf is or has been inserted), by what is called a diaphragm. These diaphragms consist of harder, solid pith, of the appearance of wood, and are examined best in canes 6 to 12 months old, when the pith has turned brown and the diaphragm is whitish. A longitudinal section through the cane will best exhibit them. They are, in most species, 1 to 2 lines thick; but in the Riverbank grape, *Vitis riparia*, the diaphragm is not more than $\frac{1}{8}$ to $\frac{1}{4}$ line thick; and in the Sand, or Rock grape, *Vitis rupestris*, it is very little thicker. For us here, the distinction of these species is of no great practical importance; but, as a considerable demand for them has sprung up in Europe, it is well to characterize them accurately; and this character holds good in winter, when all others of foliage or fruit have disappeared. There is only one American grape-vine, also in other respects an aberrant form, the Southern Muscadine grape, *Vitis vulpina*, which is entirely destitute of such diaphragms.



The cut represents the diaphragms of different species. Fig. 34, *Vitis riparia*, with the thinnest, and fig. 36, *Vitis cordifolia*, with a thick diaphragm; *Vitis æstivalis* is similar to this last, and *Vitis*

[3] Some observations (rather loose, to be sure) seem to point to the possibility of the sexual characters of the grape-vines becoming changed under certain circumstances; and, though I have not seen a case of this kind myself, nor heard of an instance where fertile vines in cultivation began to bear sterile (male) flowers, there is no absolute impossibility in it, as we know that other plants (willows for example) occasionally sport in this manner.

* A vignette representing this form of tendril appeared at the end of this paper, but is not reproduced. — Eds.

Labrusca scarcely thinner; but fig. 35, *Vitis rupestris*, has a diaphragm not much thicker than the first. Fig. 37 shows *Vitis vulpina*, without any partition.

It is well known that some species of *Vitis* grow well from cuttings, while others are difficult to propagate in this way.

Easy to propagate are *Labrusca*, *Monticola Riparia*, *Rupestris*, and *Palmata*. Almost impossible to propagate by cuttings are *Candicans*, *Æstivalis*, *Cinerea*, *Cordifolia*, *Vulpina*, and probably *Californica*. *Arizonica* and *Caribæa* I do not know in this respect. That the southern cultivated forms of *Æstivalis* grow more or less readily from cuttings is stated further on (page 16).

The structure of the bark of the young canes shows also differences in the different species, but as the characters are to some extent of microscopical detail they are here omitted. The bark of the mature canes is ashy gray (*V. cordifolia*, *V. cinerea*), to red or brownish (*V. æstivalis*); it peels off after the first season in large flakes, or in narrow strips or shreds; only in the Muscadine grape the dark gray bark does not peel off at all, at least not for a number of years.

Young seedlings of all the grape-vines are glabrous or only very slightly hairy. The cobwebby or cottony down, so characteristic of some species, makes its appearance only in the more advanced plants; in some of their varieties, and not rarely in the cultivated ones, it is mainly observed in the young growth of spring and is apt to disappear in the mature leaf; but even then such leaves are never shining as they are in the glabrous species, but have a dull or unpolished, or even wrinkled surface.

The form of the leaves is extremely variable, and descriptions must necessarily remain vague. They are usually cordate at base, either with an acute and narrow sinus (*V. cordata*, and many other species), or with a broad and wide one (*V. riparia* and *V. rupestris*). Leaves of seedling plants are all entire, i. e. not lobed; young shoots from the base of old stems, as a rule, have deeply and variously lobed leaves, even where the mature plant shows no such disposition. Some species (*V. riparia*), or some forms of other species (forms of *V. Labrusca* and *V. æstivalis*), have all the leaves more or less lobed, while others exhibit, on the mature plant, always entire, or, I should rather say, *not lobed* leaves; the leaves of *V. rupestris* and *V. vulpina* are never lobed. Only the leaves of [11 (5)] flower-bearing canes ought to be considered as the normal ones.

The surface of the leaves is glossy and shining, and mostly bright green, or in *Rupestris* pale green; or it is dull above and more or less glaucous below. The glossy leaves are perfectly glabrous, or they often bear, especially on the nerves of the lower side, a pubescence of short hair. The dull leaves are cottony or cobwebby, downy on both or only on the under side, and this down usually extends to the young branches and to the peduncles, but, as has been stated above, often disappears later in the season.

On both sides of the insertion of the petiole or leafstalk into the branchlet, we find on very young, just developing shoots, small accessory organs, which soon disappear; they are the stipules. In most species they are thin, membranaceous, rounded, at the top somewhat oblique, smooth in some, downy or woolly in other species. They are most conspicuous and elongated in *Vitis riparia*, in which I find them $2\frac{1}{2}$–3 lines long; in *V. rupestris* they are $1\frac{1}{2}$–$2\frac{1}{2}$ lines in length; in *V. candicans* and *Californica* scarcely shorter, in *V. Labrusca* $1\frac{1}{2}$–2 lines long; in *V. æstivalis*, *cordifolia*, and most others, they are only one line long or less; in very vigorous young shoots they may sometimes be larger, just as their leaves are also larger than the normal.

Not much of a distinctive character can be made out of the flowers. It is observed, however, that in some forms the stamens are not longer than the pistil, and very soon bend under it, while in other forms they are much longer than the pistil, and remain straight till they fall off. It is possible that those with short stamens are less fertile than the others.[4]

The time of flowering is quite characteristic of our native species, and it seems that the cultivated

[4] Compare note on page 9.

varieties retain herein the qualities of their native ancestors. The different forms of *Riparia* flower first of all; soon afterwards comes *Rupestris*, next *Labrusca* and its relatives, and later *Æstivalis* comes in bloom. One of the last flowering species is *Cordifolia*, and still later, *Cinerea*. *Vinifera* seems to flower soon after *Labrusca*, but it is not cultivated here, nor is *Vulpina*, which is probably the latest of all. *V. candicans* apparently blooms about the same time that *Labrusca* does.

Riparia begins to open its flowers about St. Louis three to five weeks earlier than the first blossoms of *Æstivalis* are seen in the same locality. In favorable situations and in early seasons they make their appearance in this vicinity as early as April 25th, at other seasons sometimes as late as May 15th, or even 20th, on the average about May 10th, and generally about the time when the Acacias (Black Locusts) bloom, both filling the atmosphere with the sweetest perfumes. *Cordifolia*, and, after this, *Cinerea*, on the contrary, bloom from the last days in May to (in late seasons) the middle of June, when that weed among trees, the fetid Ailantus (misnamed the Tree of Heaven), exhales its nauseous odors and the beautiful Catalpa expands its gorgeous bunches of flowers. *V. palmata* (Vahl), of which we do not yet know much, seems to be the latest flowering grape-vine with us, flowering even after *Cinerea*. Thus we are not likely to have any grape-vines in flower *here* before April 25th or after June 20th.

One of the botanical characters of the grape-vine is found in the *seeds*. The bunches may be larger or smaller, looser or more compact, branched (shouldered) or more simple, conditions which, to a great extent, depend on variety, soil, and exposure; the berries may be larger or smaller, of different color and consistency, and contain fewer or more seeds (never more than four), but the seeds, though to some extent variable, especially on account of their number [5] and mutual pressure, where more than one is present, exhibit some reliable differences. The big top of the seed is convex or rounded, or it is more or less deeply notched. The thin lower end of the seed, the beak, is short and abrupt, or it is more or less elongated. On the inner (ventral) side are two shallow, longitudinal irregular depressions. Between them is a ridge, slight where there are one or two seeds, or sharper where the seeds are in threes or fours; along this ridge the *rhaphe* (the attached funiculus or cord) runs from the *hilum*, at the beak, over the top of the seed, and ends on its back in an elongated, oval, or circular well-marked spot, called by botanists *chalaza*. This rhaphe is on that ridge represented by a slender thread, which on the top and back of the seed is entirely indistinct, or scarcely perceptible, or it is more or less prominent, like a thread or a cord. In our American species these characters seem pretty reliable, but in the varieties of the Old World grape-vine (*Vinifera*), several thousands of years removed from their native sources, the form of the seed has also undergone important modifications, and can no longer be considered so safe a guide as in our species. [12 (6)]

But different as these seeds are among themselves they have a character in common, which distinguishes them from all our American grape seeds; their beak is narrower and usually longer, and their large chalaza (the area on the back of the seed) occupies the upper half and not the centre of the seed; in the American species the beak is shorter and more abrupt; the chalaza, usually smaller, and often not circular, but narrower, is placed in the centre of the back. Any one who wishes to satisfy himself of this need only compare a raisin seed with any of our grape seeds, if the following cuts are not plain enough.

The size and weight of the seeds varies greatly in the different species, thus *Labrusca* and *Candicans* have the largest, *Cinerea* and *Riparia* the smallest seeds, but even in the wild state we find variation, e. g., in *Æstivalis*, still more in *Cordifolia*, and most in *Riparia*. In *Vinifera*, the European grape, however, the variations are much greater, greater even sometimes than our figures show. Some have laid stress on the color of the seeds, which varies between brown and yellowish, but that seems to me to go too far for our purposes.

[5] A single seed is always thicker, plumper, more rounded; two seeds are flattened on the inner, rounded on the outer side; three or four seeds are more slender and angular; these different variations may often be found in berries of the same bunch.

The cuts of 33 grape seeds, here represented, illustrate the different characters which have been mentioned above. The figures are magnified four times (four diameters), acccompanied by an outline of natural size. They all represent the back of the seed.

Figs. 1 and 2, *Vitis Labrusca*, seeds of wild plants ; fig. 1 from the district of Columbia, and fig. 2 from the mountains of East Tennessee. The seeds of the cultivated varieties do not differ from these ; they are all large, notched on top ; chalaza generally depressed and no rhaphe is visible in the groove, which extends from the chalaza to the notch.

Figs. 3 to 5 represent seeds of cultivated forms, which all show evident signs of hybridity, and acknowledge the parentage of *Labrusca* by the form and size of the seed as well as by the irregular arrangement of the tendrils. Fig. 3 is the seed of the *Taylor* Grape, which stands near *Riparia*. Fig. 4 is the seed of the *Clinton*, which has, perhaps, the same parents. Fig. 5, seed of the *Delaware Grape*, which possibly may be a hybrid of *Labrusca* with *Vinifera*.

Figs. 6 to 8, *Vitis candicans ;* seed similar to those of *Labrusca*, but broader, generally with a shorter beak, and less distinctly notched. Figs. 6 and 7 are from Texas, the latter broader and with a broader beak ; fig. 8 comes from South Florida, and is still broader and shorter.

Fig. 9, *Vitis Caribæa*, similar to the last, but smaller ; seeds short and thick, and deeply notched.

Figs. 10 and 11, *Vitis Californica*, seeds often smaller, scarcely or not at all notched, rhaphe indistinct or quite invisible ; chalaza narrow and long. Fig. 10 represents a single seed (one only in a berry) from near San Francisco ; fig. 11 is one of four seeds from San Bernardino, in Southern California.

Fig. 12, *Vitis monticola ;* seed very similar to those of the last species, thick, notched, without a distinct rhaphe, and with a long and narrow chalaza.

Figs. 13 and 14, *Vitis Arizonica*, from the Santa Rita Mountains ; seeds small, slightly notched, with a more or less distinct but flat rhaphe.

Figs. 15 to 17, *Vitis æstivalis ;* seeds rather larger, cord-like rhaphe and more or less circular chalaza strongly developed ; all the seeds are from wild grapes gathered about St. Louis ; the seeds of the cultivated forms, Northern and Southern, are similar. Figs. 15 and 16 are from berries with only one or two seeds ; fig. 17 is narrower, and from a larger four-seeded berry.

Fig. 18, *Vitis cinerea*, a seed similar to the last, with the same strong rhaphe, but smaller in size, and often single.

Figs. 19 and 20, *Vitis cordifolia ;* seeds also similar to the last two, but rhaphe not quite so prominent, mostly single or in twos, rarely more in a berry ; fig. 19 comes from a larger berry, with more seeds, found near St. Louis ; fig. 20 is a single seed, from the District of Columbia.

Fig. 21, *Vitis palmata ;* seed large, almost globose, with a very short beak, a narrow chalaza, no rhaphe visible, top slightly depressed.

Figs. 22 to 25, *Vitis riparia ;* seeds similar to the last, but smaller, though quite variable in size. The seeds all come from wild plants : figs. 22 and 23, from Goat Island on the Niagara Falls ; fig. 22, a single broad seed; fig. 23, from a three-seeded berry ; fig. 24, from a two-seeded berry from the shores of Lake Champlain, in Vermont ; fig. 25, seed of the June grape from the banks of the Mississippi below St. Louis. The seeds are obtuse, or very slightly depressed on top, chalaza rather flat, elongated and gradually lost in a groove which encloses the scarcely prominent rhaphe.

Figs. 26 and 27, *Vitis rupestris ;* fig. 26, from a two-seeded berry from Texas, and fig. 27, from a four-seeded one from Missouri. The top of the seed is obtuse, not notched, and the rhaphe very inconspicuous in the Texan seed, or invisible in that from Missouri.

Figs. 28 to 32, *Vitis vinifera*, from the Old World. Different forms are introduced here for comparison with the American species, and to show how much they differ among themselves. Fig. 28 represents a seed out of a lot of grapes (or raisins) found with an Egyptian mummy, and probably now 3,000 years old, or older. The specimens are preserved in the Egyptian Museum of Berlin. The berry obligingly donated to me was as large as the larger European cultivated grapes, and enclosed three seeds. It will be seen that it is the largest of the *Vinifera* seeds figured here, showing perhaps a slight modification of the seed in the ages that intervened between its and our times.

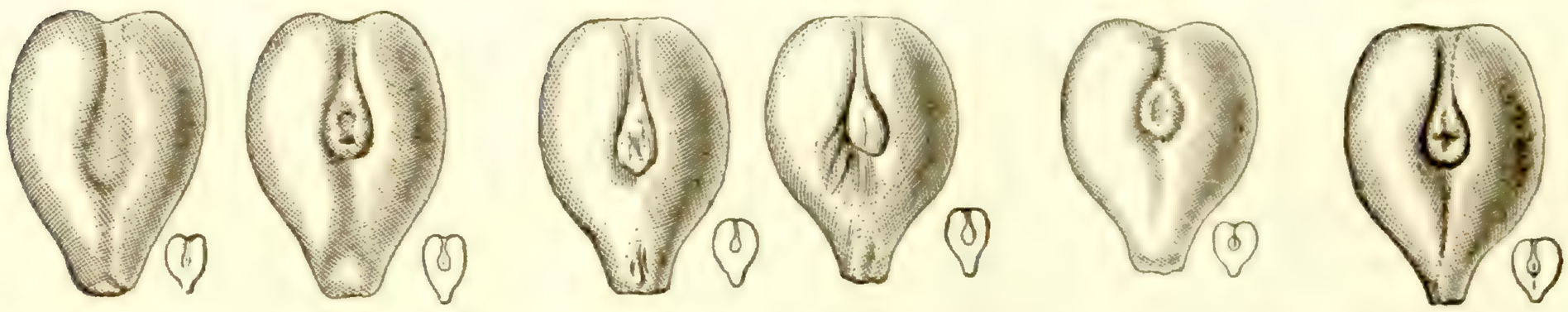
Fig. 29, *Brusca*, the native species of Tuscany (Northern Italy), fig. 30, *Riesling*, cultivated on the banks of the Rhine ; fig. 31, *Gutedel* (*Chasselas*), from the same region ; fig. 32, *Black Hamburg*, from a grapery near London. All these seeds are easily distinguished from all American grape seeds, by the narrower and usually longer beak (or lower part), and especially by the large circular, though not very prominent, chalaza, which occupies the upper, and not the middle part of the seed. These five specimen seeds represent the principal forms, but not all European grape seeds entirely agree with them. [14 (8)]

Fig. 33, *Vitis vulpina* (or *rotundifolia*), from the South Carolina Muscadine grape, different from all other grape seeds, just as the plant differs from all the other grape-vines ; seed very flat, with straight sides, very short beak, wrinkled, or rather folded on both surfaces, notched on top, with very narrow chalaza and no visible rhaphe.

TABLE OF GRAPE SEEDS. [13]

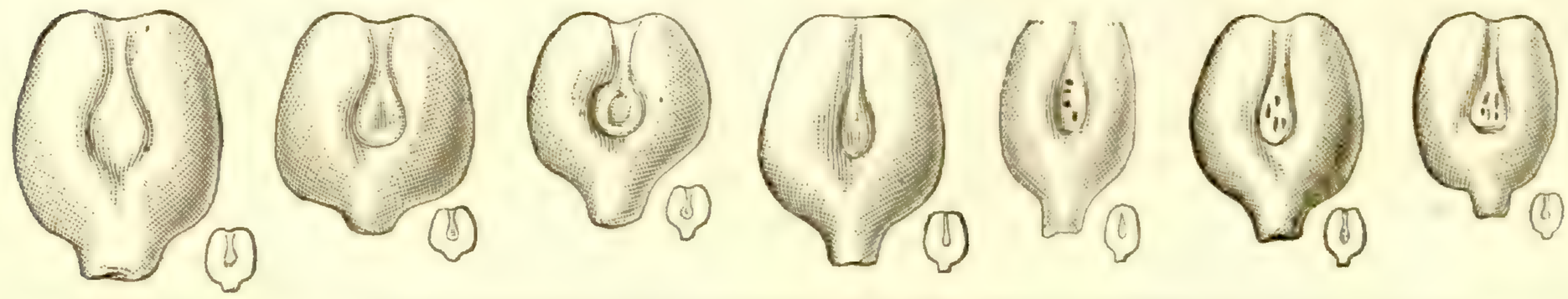
V. LABRUSCA. TAYLOR. CLINTON. DELAWARE. V. CANDICANS.

FIG. 1. FIG. 2. FIG. 3. FIG. 4. FIG. 5. FIG. 6.



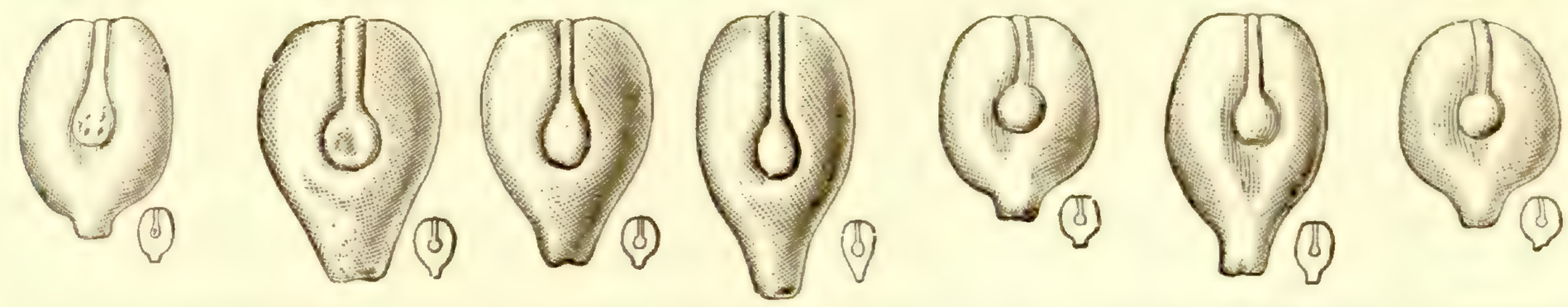
V. CANDICANS. V. CARIBÆA. V. CALIFORNICA. V. MONTICOLA. V. ARIZONICA.

FIG. 7. FIG. 8. FIG. 9. FIG. 10. FIG. 11. FIG. 12. FIG. 13.



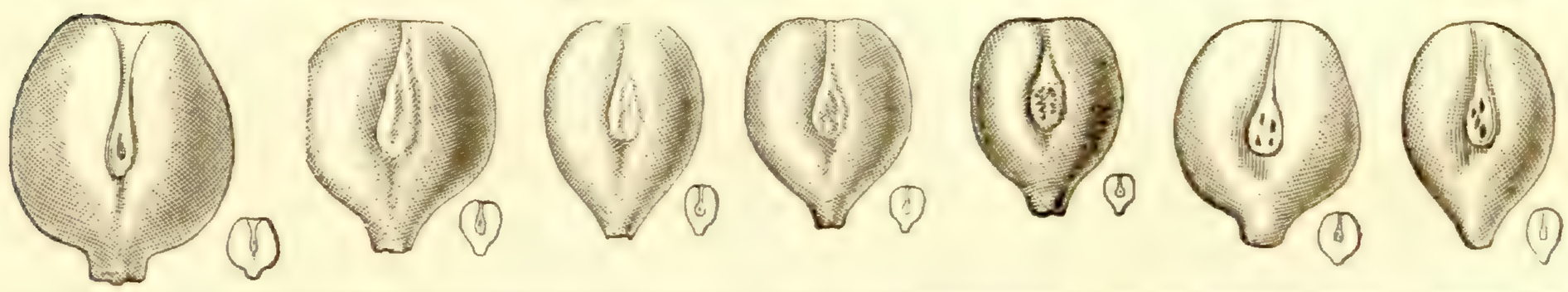
V. ARIZONICA. V. ÆSTIVALIS. V. CINEREA. V. CORDIFOLIA.

FIG. 14. FIG. 15. FIG. 16. FIG. 17. FIG. 18. FIG. 19. FIG. 20.



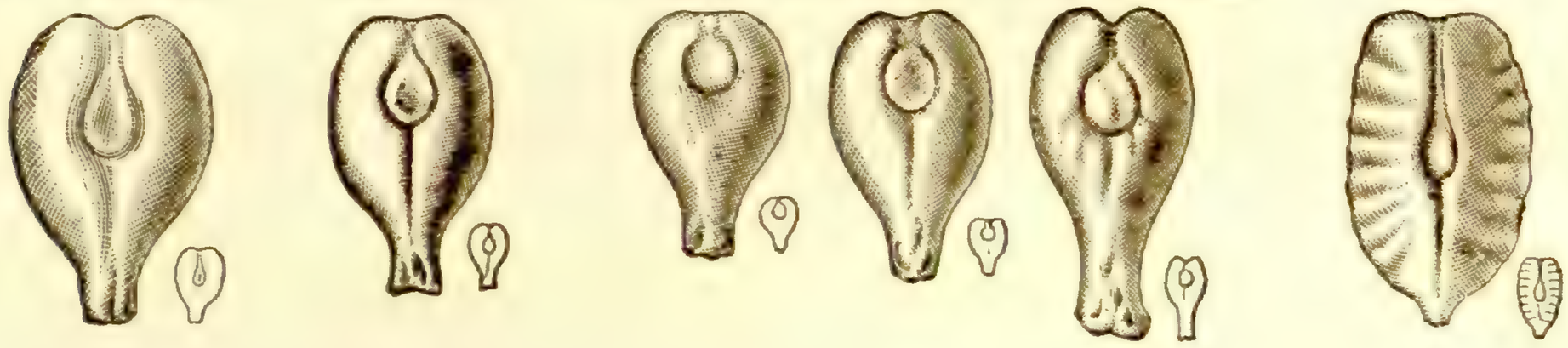
V. PALMATA. V. RIPARIA. V. RIPARIA. V. RUPESTRIS.

FIG. 21. FIG. 22. FIG. 23. FIG. 24. FIG. 25. FIG. 26. FIG. 27.



V. VINIFERA. V. VINIFERA. V. VULPINA.

FIG. 28. MUMMY GRAPE. FIG. 29. BRUSCA. FIG. 30. RIESLING. FIG. 31. CHASSELAS. FIG. 32. BL. HAMBURG. FIG. 33.



The North American grape-vines may be systematically arranged in the following order: —

I. True grape-vines, with loose, shreddy bark, climbing by the aid of forked tendrils, or sometimes (in No. 12) almost without tendrils.

A. Grape-vines with more or less continuous tendrils.

1. VITIS LABRUSCA, *Linn.*, the northern Fox-grape, the mother of a great many cultivated varieties and hybrids.

B. Grape-vines with intermittent tendrils.

a. Leaves pubescent or floccose, especially on the under side and when young, often becoming glabrous with age.

* Rhaphe on seed indistinct.

2. VITIS CANDICANS, *Engelm.* The Mustang grape of Texas.
3. VITIS CARIBÆA, *DC.* The West India grape; rare in Florida.
4. VITIS CALIFORNICA, *Benth.* The California grape.
5. VITIS MONTICOLA, *Buck.* The Mountain grape of West Texas.
6. VITIS ARIZONICA, *Engelm.* The Arizona grape.

** Rhaphe on back of seed very conspicuous.

7. VITIS ÆSTIVALIS, *Michx.* Summer grape of the Middle and Southern States, with several varieties.
8. VITIS CINEREA, *Engelm.* The Downy grape of the Mississippi Valley.

b. Leaves glabrous, or sometimes short-hairy, especially the ribs beneath; mostly shining.

* Rhaphe on back of seed conspicuous.

9. VITIS CORDIFOLIA, *Michx.* Frost grape of the Middle and Southern States.

** Rhaphe indistinct.

10. VITIS PALMATA, *Vahl.* Red grape of the Mississippi Valley.
11. VITIS RIPARIA, *Michx.* Riverside grape of the United States and Canada.
12. VITIS RUPESTRIS, *Scheele.* Rock or sand grape of the Western Mississippi Valley and Texas.

VITIS VINIFERA, *Linn.*, the Wine-grape of the Old World and California, would find its systematic place here.

II. Muscadine grape, with (on the younger branches) firmly adhering bark, which only in the older stems scales off; aerial roots from inclined trunks in damp localities; tendrils intermittent, simple; berries very large (7–10 lines thick), very few in a bunch, easily detaching themselves at maturity; seeds with transverse wrinkles or shallow grooves on both sides.

13. VITIS VULPINA, *Linn.* (ROTUNDIFOLIA, *Mich.*). The southern Fox-grape or Muscadine.

Rafinesque, Le Conte, and others, have in times gone by attempted to distinguish and characterize a good many more species, while on the other hand, Director Regel, of the St. Petersburg Botanical Garden, has lately tried, rather unnaturally, to contract them and unite them with Old World species. *Vitis vinifera* has resulted, according to his views, from the hybridization of several of these species.

I now propose to give a short botanical account of the 13 species enumerated above, leaving to the author of this treatise the task to add the important practical remarks which the subject calls for.

1. VITIS LABRUSCA, *Linn.* Usually not large; climbing over bushes or small trees, occasionally reaching the tops of the highest trees; distinguished from all the other species, as has been stated above, by its continuous tendrils and consequently by its continuous (2 to often 4 or 6) clusters of flowers and fruit; stipules middle-sized, about 2 lines long, or less; leaves large (4 to 6 inches wide), thick, of firm texture, entire or in some forms deeply lobed, very slightly dentate, coated when young with a thick rusty, or sometimes whitish down, which in the wild plant persists on the under side, but almost disappears in the mature leaf of some cultivated varieties; berries large in middle-sized, or, in many cultivated forms, rather large bunches, bearing 2 or 3 or even 4 seeds, large, notched, without visible rhaphe. (See table of seeds, page 13, figs. 1 and 2.)

This species, usually known as the Fox-grape, or Northern Fox-grape, is a native of the Alleghany Mountains, and of their eastern slope to the sea-coast, from New England to South Carolina, where it prefers wet thickets or granitic soil. Here and there it descends along streams to the western slope of the mountains, but is a stranger to the Mississippi Valley proper.

As the *Labrusca* generally grows on granitic soil or granitic detritus, which may favor the vine, I would suggest to plant Catawba vineyards in the granitic regions of our Ozark Mountains, and would expect favorable results there.

By far the largest number of varieties of grape-vines now cultivated in our country are the offspring of this species; a few produced by nurserymen, but most of them picked up in the woods; they are easily recognized by the characters above given, and most readily by the peculiar arrangements of the tendrils as above described. Large and downy-leaved varieties of *V. æstivalis* are, in the West and South-west, not rarely mistaken for *Labrusca*, but the two may always be distinguished by the characters indicated.

It is also the species which has most generally been used as one of the parents (mostly the mother) in artificial hybridization, and as it is the most individualized or specialized of all our (perhaps of *all* known) grape-vines, its characters unmistakably prevail in the hybrids, and rarely leave a doubt as to where to refer the questionable form; of which I shall have to add a few words below, under the head of *Hybrids*.

2. VITIS CANDICANS, *Engelm.* (*V. mustangensis*, Buckley.) The mustang grape of Texas; a tall climber, with rather large, rounded, almost toothless leaves, white cottony on the under side, bearing large berries, which, like those of the wild *Labrusca*, show different colors, greenish, claret, and bluish-black; and which, in its native country, are made into wine. In young shoots and sprouts the leaves are usually deeply and elegantly many-lobed, which, with the contrast of the deep green upper and pure white under surface, would make this species a most elegant vine for arbors, if it could be protected from severe frost. This may be done by laying it down and covering it with soil. In Texas it grows in the lower country, as well as on the calcareous hills, and extends even into the granitic region. It has also been found in Florida, where many Texas plants are again met with. The Florida form, at one time taken for *Vitis Caribæa*, but quite distinct from it, has shorter and comparatively thicker seeds. (Fig. 8.)

3. VITIS CARIBÆA, *DC.*, is a West Indian species which has lately found its way, with other tropical plants, into Southern Florida. It has a downy, cordate leaf, not lobed, but characterized by the small but very sharp, distant teeth. Its black berries are small and mostly bear but one or two seeds. I find the Florida seeds (fig. 9) which were kindly sent to me by Mr. A. H. Curtiss, the discoverer, larger than those of the West Indian type.

4. VITIS CALIFORNICA, *Benth.* The only wild grape of our Pacific coast; a low bush a foot or two high, in dry beds of streams in Southern Oregon; it becomes a tall climber in Southern California, with a stem 3 inches or more in diameter; it is distinguished by its cordate, rounded, whitish, downy leaves, and small black berries in large bunches; the obtuse but scarcely notched seeds (figs. 10 and 11), without or with only a trace of a rhaphe, and with a narrow, long chalaza. No use is made of this species, but it has lately been recommended as a grafting stock for European vines in California vineyards which have been attacked by the phylloxera. For even this grape-vine, which is a native of a country originally entirely free from the insect, is as proof against it as any of our Mississippi Valley vines.

5. VITIS MONTICOLA, *Buck.* Usually a small, bushy vine, rarely climbing over higher trees; branchlets angled; young stems, petioles, and leaves cottony, downy, the down gradually disappearing, remaining only here and there in floccose bunches; stipules very short ($\frac{1}{2}$ line long); leaves deeply cordate, with a rounded sinus, very shortly 3-lobed, edged with small but broad teeth, rather wrinkled on the upper surface, but the older ones very smooth and often conspicuously shining below (especially in the dry specimens); usually small, not more than 3 inches across, only on vigorous shoots 3 or 4 inches wide; tendrils intermittent, in the smaller, bushy forms, often withering away; bunches of fruit, compact, short; berries 4, or rarely 5 lines in diameter; seeds obtuse or slightly notched, chalaza rather narrow, extending upward into a broad groove, but without a visible rhaphe.

This is one of the smaller species, and is peculiar to the hilly, cretaceous region of Western Texas, not extending to the lower country nor to the granitic mountains; common about San Antonio, New Braunfels, Austin, etc.; also occasionally cultivated about San Antonio, when the bunches, as well as the berries, become larger. This plant has given rise to a great deal of speculation and controversy. About fifty years ago, the Swiss botanist, Berlandier, collected it in West Texas,[6] but it was not till twenty-five or thirty years later that Prof. Buckley named and published it. Unfortunately his description was so insufficient that no botanist could recognize the plant; only the Texans of those regions, who well knew "the little mountain grape," understood what he meant. Buckley's mention of a middle-sized, green, very palatable berry has misled French botanists to look for this plant among the numerous forms of *Labrusca*, and Prof. Planchon therefore changed the name to *Vitis Berlandieri*. In justification of Buckley's description it is now said that there exists a form of this species, especially about Fredericksburg and on the borders of the Llano Estacado, with somewhat larger, green berries, which I understand Mr. J. Meusebach is trying to find out, and to introduce into cultivation. The species will readily grow from cuttings. [16 (10)]

6. VITIS ARIZONICA, *Engelm.* is closely related to the last, and has similar seeds, but the flat rhaphe, though rarely prominent, is broad and sometimes inconspicuous; branchlets angular; leaves cordate, with a rather open, rounded sinus, not lobed, or with 2 short, latent lobes; floccose, cottony when young; glabrous, thick, very rigid, and (especially on the upper surface) rough, when older; berries small or middle-sized, reported to be of luscious taste.

7. VITIS ÆSTIVALIS, *Michx.* Climbing over bushes and small trees by the aid of forked, intermittent tendrils; branchlets rounded, bark of the mature ones mostly red, and scaling off in large flakes; leaves large (4–5 or 6 inches

[6] On his specimens I found the first phylloxera galls, which, thus accidentally preserved, prove the existence of the insect in America (doubted, however, by no one now) long before it became known to science here or in the Old World, and also prove its existence as far south as Texas.

wide), of firm texture, entire, or often more or less deeply and obtusely 3–5 lobed, with rounded sinus, and with short and broad teeth; when young always very woolly or cottony, mostly bright red or rusty; at last smoothish but dull, pale or glaucous beneath, and never shining; stipules very short and rounded, mostly rusty-downy; berries middle-sized, black, 5–7 lines, in southwestern forms even 8–9 lines in diameter, coated with a bloom, when well grown in compact, often cylindrical bunches; seeds rather large, mostly 2 or 3 in each berry, rounded on top, showing a very prominent, cord-like rhaphe, and more gradually attenuated into the beak than is common in our species.

This is the well known summer grape, common throughout the Middle and Southern States, usually found on uplands, and in dry, open woods or thickets, maturing its fruits in September. It is one of the most variable of our grape-vines, and hence has seduced many into the establishment of numerous nominal species, while others, and among them myself, have assumed too wide limits for the species, and have classed under it forms which now, since we know them better, have to be kept separate. Among the latter I mention *V. monticola* and *V. cinerea*, which are described in their proper places. Among the former I must still retain with *V. æstivalis* the form that had been distinguished by Buckley as *V. Lincecumi*. This latter, often more bushy than climbing, has larger berries, leaves often deeply 3 to 5-lobed, and coated with a thick rusty down, or tomentum, which is often quite persistent. Forms with very large, woolly leaves have often been taken for *Labrusca*, and this species, abounding in the sandy post-oak (*Quercus stellata*) woods of Eastern Texas, and there known under the name of post-oak grape or sand grape, but extending also to Arkansas and Missouri, has thus been quoted for the Western and Southwestern States, to which the true *Labrusca* is an entire stranger.

This species is one of the most important ones for us, and in the West at least has already taken the place once accorded to the *Labrusca* forms in our cultures, not only for their greater, aye absolute, resistance to the phylloxera, but also for their intrinsic value as wine (and even table) grapes, notwithstanding the superior size of the *Labrusca* berries. Unfortunately the typical forms cannot be propagated by cuttings, and there are a number of varieties which, originating from a southern home, are not quite hardy here, but, on the other hand, have the advantage of being readily propagated by slips, in some favorable localities. Their leaves are thinner than those of our type, and woolly only in the first youth; the bunches are larger, more shouldered; the berries, though small, are much sweeter and more juicy. They comprise, among others, the *Cunningham* with less divided, and the *Herbemont* and the *Lenoir*, with deeply lobed leaves, the two former with lighter colored, the latter with deep black berries. Unfortunately no wild plant from which these varieties might have sprung is yet known, but must be looked for in the mountains or hills of the Carolinas and Georgia, and only when found in a wild state can we correctly judge of their botanical status. About their viticultural relations, the body of this work has to be consulted. I will only state here that a slight suspicion exists of their being hybrids between *V. æstivalis* and some form of *Vinifera*, though the seeds are entirely those of the former, and also the resistance to phylloxera. The variety *Lenoir*, often named *Jaquez*, and in Texas *Black Spanish*, has been introduced by millions into Southern France, and is there found to furnish not only an excellent stock whereon to graft their own vines, but also to make a superior wine directly, and one very rich in the deep coloring matter so highly prized there.

8. VITIS CINEREA, *Engelm.* Closely allied to *Æstivalis*, with which I had formerly united it as a variety, of pretty much the same size, rarely taller. It is distinguished by its whitish or grayish pubescence, which, especially on the branchlets, is quite persistent, even into winter; by the angular branchlets, the hair being especially developed on the angles; the cordate often entire, or slightly 3-lobed, more or less gray-downy leaves, which often resemble a linden leaf, with a rounded, but usually rather narrow sinus; by the large, loose inflorescence, which opens its flowers rather later than any other of our species; by the small black berries, about 4 lines in diameter, without a bloom, of a pleasantly acid taste, until frost sweetens them, and by the small, plump seed with a short beak. [17 (11)]

This species is found in rich soil in the Mississippi Valley from Central Illinois to Louisiana and Texas, especially in bottom lands and along the banks of lakes, in situations where we scarcely ever meet with *Æstivalis*. It is quite abundant in such localities near St. Louis.

9. VITIS CORDIFOLIA, *Michx.* This is the tallest of our climbers at home in our deep bottom woods, but often also a low trailer over bushes and hedges, well known as the Winter, or Frost grape, flowering late and maturing late its strongly flavored, shining black berries.

The plant is glabrous, or the branchlets and lower surface of leaves somewhat hairy; branchlets indistinctly angular (in this respect intermediate between the last two species); diaphragm at the nodes of the branches thick, rarely, at the lower nodes, wanting; leaves rather large, 3 to 4 inches wide, or more, not lobed at all, or slightly 3-lobed, cordate, with a deep narrow, or wider, but always sharp sinus, margined with conspicuous, rather large sharp-pointed teeth; stipules short; flowers in large, usually loose clusters, blooming rather late; berries small (3 to 4 lines through), black and shining, with a peculiarly disagreeable and strong flavor; edible only after frost; seed, with slight or strong rhaphe.

A common plant from the Middle States southward to Texas ; not known, I believe, in Northern New York or New England, but not rare in Pennsylvania and New Jersey, and found also near the city of New York ; very common in the deep soil of the western river valleys, where it takes its fullest development. There the trunk sometimes reaches thirty to thirty-eight inches in circumference (Southern Missouri, along the Iron Mountain Railroad) ; whether the trunk found by Mr. Ravenel at Darien, Georgia, measuring forty-four inches around, belongs to this species, I cannot tell, but his supposition that it was *Æstivalis* is quite improbable ; the statement of newspapers that a grape-vine in Gulf Hammock, in Florida, had a circumference of sixty-nine inches, is considered a "fish story" by Florida botanists.

The acute, mostly narrow sinus of the leaves, the small stipules, the broad diaphragms, the character of the seeds, the circumstance that it don't grow from cuttings, and the late flowering time, abundantly distinguish this species from *Vitis riparia*, with which it has been thrown together so long and so obstinately.

10. VITIS PALMATA, *Vahl*, has been cultivated in the Jardin des Plantes in Paris for perhaps one hundred years or more, and has thence found its way into other European gardens, without, however, as it seems, having attracted the attention of botanists, since its first publication, in 1794.

Vahl's description is accurate enough, with the exception of its native country, which he gives as "Virginia," a negligence or ignorance which we must not criticise too severely in botanists of a century ago. The seed was originally brought to Paris probably by French missionaries, who, as is well known, roamed about in the Mississippi Valley one and two hundred years ago. Soon after the publication of Vahl's description of this grape, above mentioned, Michaux discovered this interesting species "growing abundantly on the banks of the streams in Illinois," and named it *V. rubra*. He don't seem to have recognized the vine which he might have seen growing under his eyes in Paris, and eventually he merged his specimens of this *Vitis* in his herbarium under *V. riparia*.

Last fall Mr. H. Eggert, of St. Louis, re-discovered this long neglected plant on the banks of the Mississippi, opposite Alton, and collected it there again this summer, when it proved to be the latest blooming of all our species (far from blooming yet to-day, June 10th). There can be no doubt of the identity of this plant with Vahl's *V. palmata* and Michaux's *Rubra*, nor of its entire distinctness from *Riparia*. It is found, with this last one, covering willow thickets and other bushes in low grounds, overflowed during high water. Its bright red branches, from which the bark separates in large flakes, conspicuous between the smooth but dull, darkish foliage (much darker than *Riparia*), show at once how appropriate Michaux's name is. The diaphragms are thick. The leaves have a broad sinus, and are shallow or often deeply 3, rarely 5-lobed, the lobes usually drawn out into long and slender points; the under side is often somewhat hairy along the nerves ; stipules middle sized, 1½ to 2 lines long ; flower-bunches large and loose, on long stems ; berries rather small (4–5 lines through), black, without bloom ; seeds 1 or 2, very large and plump, rounded, with very short beak, notched on top, without a visible rhaphe.

Our plant is readily distinguished from *Riparia* by the thick diaphragm, the red branches, its late [18 (12)] flowering and its bloomless, late ripening berries ; from *Cordifolia* the form of the leaves and of the seeds, and its ready growth from cuttings, easily separate it.

11. VITIS RIPARIA, *Michx.*, the grape-vine of the river banks, has lately acquired a great deal of importance, as it has now become the principal grape-vine relied on in France for the renovation of their failing vineyards, for which its vigorous growth, adapted to almost all climates, its perfect resistance to the insect, its easy growth from cuttings, and its ready taking of grafts, seem to peculiarly fit it.

This species climbs over bushes and small trees, or trails over the rocks on our river banks. It is also found inland, always near water, on larger trees, where its trunk may become 6 inches thick. The branchlets are rounded, not angled ; the diaphragms very thin (⅛ to ¼ line thick) ; the stipules large (2–3 lines long) and very thin, and persist longer than in most other species ; leaves of a light green, shining glabrous or often hairy below, with a wide, rounded, or even truncate sinus; they are more or less trilobed, margined with large, sharp-pointed teeth. The bunches are mostly small and compact ; berries small (4 or rarely 5 lines in diameter), black, with a bloom, sweet and very juicy, scarcely pulpy ; seeds (figs. 22 to 25) obtuse or slightly notched, with a narrow chalaza, rhaphe indistinct or very thin.[7]

It has the widest geographical distribution of any of our grape-vines, and is the hardiest of them all. It extends northward to Lake St. Jean, ninety miles north of Quebec, and to the banks of the Upper Mississippi in Minnesota, and the shores of Lake Superior ; in the South it is common on the banks of the Ohio and in Kentucky, Illinois, Missouri and Arkansas,[8] and in the Indian Territory. I have not seen it from Louisiana or Texas, but a form of it is

[7] The French now distinguish several types of *Riparia*, differing somewhat in their minor characteristics. See our Viticultural Remarks.

[8] A peculiar form of *Riparia* is a plant which I found fifteen years ago in the Botanic Garden of Berlin, under the name of *Vitis Solonis*, and about the history of which nobody seems to have known anything. Lately this plant has been taken up in France with that zeal so characteristic of that nation, as something possibly of particular interest for their viticultural pursuits. It is distinguished from the ordinary form by the long and narrow, almost incised, crowded teeth of the scarcely three-lobed leaves. The name is undoubtedly

found in the Rocky Mountains of Colorado and New Mexico, and perhaps in Southern Utah. It is the earliest flowering species about St. Louis, according to season, between April 25th and May 15th, and matures earlier than any other. In St. Louis it used to be brought to market, before we had cultivated grapes, sometimes as early as July 1st, from the rocky, sun-exposed banks of the river below town, and was, indeed, known as the June grape. From that time on ripe fruit is found, according to locality, through August and September. It is singular that our vintners, as far as I can learn, have never made wine from this species, nor tried to cultivate and improve it. The berries probably seem too small, and they may have expected better results from the larger fruits of *Æstivalis;* but the experiment might yet be made, and our woods might be examined for larger-fruited varieties, which really do occur, e. g., along the Lakes and on Niagara, near Detroit, etc.

As has been stated above, this species has been confounded with *Vitis cordifolia,* to which indeed it bears a certain resemblance ; but the characters enumerated, especially those of the diaphragms, the stipules, the form of the leaf and its base, its flowering time, and above all the seeds, distinguish them as well as any two species can be distinguished, even if the difficulty of one and the readiness of the other to grow from cuttings be not taken into account.

12. Vitis rupestris, *Scheele,* mostly a low, bushy plant, often without any, or with weak, deciduous tendrils, and not climbing, under favorable circumstances becoming stouter and climbing pretty high ; branchlets rounded, diaphragm thicker than in *Riparia,* but thinner than in other species ; leaves rather small (about 3 inches wide), broadly cordate, rarely very slightly lobed, mostly broader than long, usually somewhat folded together, with broad, coarse teeth, and commonly with an abruptly elongated point, glabrous, shining, of a very pale green color ; stipules almost as large as in last species, 2–2½ lines long, thin ; berries small or middle sized, sweet, and in very small bunches ; seeds obtuse, with a slender or almost invisible rhaphe.

This grape-vine, of very peculiar aspect, is a native of the hilly country west of the Mississippi River, from the banks of the Missouri to Texas, and is also found on the Cumberland River near Nashville ; its favorable localities are gravelly banks or bars of mountain streams, overflowed in spring, more rarely (in Texas) on [19 (13)] rocky plains. In Missouri it is called Sand grape, in Texas often, on account of its luscious fruit, Sugar grape ; with us it flowers soon after *Riparia* and ripens in August, and is said to make a good wine. In France the *V. rupestris* is used, like the last species, as a grafting stock for French vines ; it grows easily from cuttings, and is said to make vigorous plants, perfectly resistant to the insect.

Vitis vinifera, *Linn.* Here would be the place to introduce the grape-vine of the Old World, as it is most nearly allied to the last-enumerated species, especially to *V. riparia.* Though many of its cultivated varieties bear berries as large, or even larger, than those of any of our American grape-vines, other cultivated forms, and especially the true wine-grapes, those from which the best wines are obtained, and also the wild or naturalized ones, have fruit not much larger than that of the above named native species.

This plant, together with the wheat, belongs to those earliest acquisitions of cultivation, the history of which reaches beyond the most ancient written records. Not only have the sepulchres of the mummies of ancient Egypt preserved us fruit (large sized berries) and seed, but its seeds have even been discovered in the lacustrine habitations of Northern Italy. It is a mooted question where to look for the native country of this plant, and whether or not we owe the different varieties of our present *Vinifera* to one or to several countries, and to one or to several original wild species, which, by cultivation through uncounted ages, and by accidental and repeated hybridization, may have produced the numberless forms now known. These remind us forcibly of the numerous forms of our dog, which we cannot trace, either, but which can scarcely be derived from a single (supposed) original wild species. Director Regel, of St. Petersburg, ascribes them to the intermingling of a few species, well known in their wild state at this day. The late Prof Braun, of Berlin, suggested that they are the offspring of distinct species yet found wild in many parts of Southern Europe and Asia, which thus he considered not the accidental offspring of the cultivated plants, as is generally believed, but the original parent stock. I may add, from my own investigations, that the grape-vine which inhabits the native forests of the low banks of the Danube, — "bottom-woods," as we would call them, — from Vienna down into Hungary, well represents our *V. cordifolia,* with its stems 3, 6, and 9 inches thick, and climbing on the highest trees, its smooth and shining, scarcely lobed leaves, and its small, black berries. On the other hand, the wild grape of the thickets of the hilly countries of Tuscany and Rome, with its lower growth, somewhat cottony leaves, and larger and more palatable fruit, which "don't make a bad wine," as an Italian botanist expressed himself to me, reminds us, notwithstanding the smaller size of the leaves, of the downy forms of *Riparia,* or

a corruption of "Long's," and the plant comes from the Upper Arkansas River, where Major Long, on his return from his expedition to the Rocky Mountains, found, as he reports, such excellent grapes. Seeds may have been brought home and the plant raised as "Long's." A manuscript of the viticulturist Bronner, preserved in the Carlsruhe library, speaks of a certain grape-vine as "Long's, from Arkansas," and it is reported that Long's is still growing in the late Mr. Bronner's garden at Wisloch, near Heidelberg, and that it is identical with *Solonis.* As an example of curious speculative interpretation it may be stated that some viticulturist had read for *Solonis Zanis* (an oriental grape), and for *Arkansas Caucasus.*

perhaps of some *Æstivalis*. It was known to the ancients as *Labrusca*, a name improperly applied by science to an American species, and is called by the natives to this day *Brusca*. The grape-vines of the countries south of the Caucasus Mountains, the ancient Colchis, the reputed original home of these plants, greatly resemble the Italian plant just described.

The European grape-vine is characterized by smoothish, and, when young, shining more or less deeply 5, or even 7-lobed leaves; lobes pointed and sharply toothed; seeds mostly notched at the upper end; beak elongated; rhaphe indistinct; chalaza broad, high up the seed. In some varieties the leaves and branchlets are hairy and even downy when young; the seeds vary considerably in thickness and length, less so in the shape of the rhaphe. It is well known that the plant grows readily from cuttings, and that it easily and almost invariably succumbs to the attacks of the phylloxera, which, accidentally introduced into France, probably with American vines, has done such immense damage in that country and in the rest of Europe, probably since 1863 (though only discovered as the virulent enemy in 1868), and is spreading more and more. In California, where thus far the *Vinifera* has been successfully cultivated, the insect also begins to make its appearance in some localities. That it was the cause of the complete failure in all the efforts to plant the European vine east of the Rocky Mountains, is now well known.

13. VITIS VULPINA, *Linn.* (known also as *V. rotundifolia,* Michx.), the Southern Fox-grape, Bullace or Bullit grape, or Muscadine of the Southern States, is entirely different from all our other grape-vines, and is mentioned here only to complete the list of our species. It is too tender for our climate, and never flowers or fruits here. It is found in damp thickets or on mountain slopes, sometimes a low bush, and again climbing very high, with entire, never forked, tendrils; branchlets without any diaphragm (see fig. 37); leaves small (2, or at most, 3 inches wide), rounded, heart-shaped, firm and glossy, dark green, smooth, or rarely slightly hairy beneath, with coarse and large or broad and bluntish teeth. The bunches are very small, of few very large berries, which fall off singly, like plums. The peculiar seed has been figured and described above (page 13, fig. 33). In the South some of the varieties are highly esteemed, especially the White Scuppernong.

HYBRIDITY.

Plants so intimately related among themselves as these, are apt to hybridize, and their offspring is usually fertile, not, like many hybrid animals (the mule) or plants, incapable to propagate. We have a number of artificial hybrids among grape-vines, whose history is well known, and which bear as well as the true species, and their seeds are fertile. But we also find other vines in the woods or in vineyards, which, from their characters, we must conclude to be spontaneous hybrids. There is, of course, a good deal of experience and judgment necessary to decide what may be justly claimed to be a hybrid, and what only a variety within the limits of some va- [20 (14)] riable species, and the opinions of different persons may honestly vary on these points.

But whoever has studied the great variability of many plants will hesitate long before he calls to his aid the often fanciful help of hybridity in the explanation of doubtful forms. Where species are so well marked as e. g., *Labrusca* is, it is not difficult to recognize some of its characters in a hybrid offspring, though the general looks of the questionable plant otherwise may not conform to our idea of *Labrusca* at all; but in other cases, where species already stand near one another, the matter becomes much more difficult. But there is another way, unfortunately a very tedious one, to assist in such investigations, viz.: to sow the seeds of hybrids and study their offspring; for it is a fact that seedlings of hybrids are apt to revert to, or at least to approach to, one or the other of the parents. One of the most striking examples of both positions here taken is furnished by the well-known Taylor or Bullit grape. The vigorous growth of this form, its thin diaphragms, its glossy, glabrous foliage, its small clusters of rather small berries entirely destitute of foxy taste, all seem to point to it as a cultivated variety of *Riparia;* but when we come to examine the tendrils we find that they are irregular; sometimes intermittent, sometimes more or less continuous (I have seen six in succession, which can only point to *Labrusca*), and just so the seeds differ from *Riparia* seeds by their great size and their form (see page 13, fig. 3). Now it so happens that Taylor seeds have been planted by the million in Europe, in order to raise resistant stock for grafting, and the general experience is that one cannot find two seedlings in a hundred alike, and similar to the mother-plant; some approach the *Riparia* type, and others show the *Labrusca* parentage distinctly. Thus, to give

only one example, one of such seedlings — the now frequently cultivated *Elvira* — is a Taylor seedling with a close approach to *Labrusca*.

It would further the study of our grape-vines considerably if some of those that have the zeal, the leisure, and the opportunity, would institute such experiments with doubtful forms.

Pursuing this interesting subject further, I may add that where nearly allied species grow near together, and bloom about the same time, they are more likely to hybridize than such species that are separated by wide space or different period of flowering. With all these considerations we must not forget that with the innumerable opportunities given everywhere for hybridization we find comparatively so few spontaneous hybrids in the vegetable world. Hybridization is an abnormal, I may say, an unnatural process, which is usually prevented by countless obstacles. If it were not so, we would meet with more hybrids in our woods and prairies than with genuine species; but how rare are they, and what a find it is for a botanist to discover one! And this is the more to be wondered at, because the genital organs of the plants, though mostly united in one flower, are usually so organized that self-fertilization is made difficult, or is excluded, and that cross-fertilization is the rule. We may put it down as a law that honest nature abhors hybridization.

IV. COLLECTED DESCRIPTIONS OF VITIS.

From Addenda to Gray's Manual of the Botany of the Northern United States. New York, 1868.

2. Vitis æstivalis, var. ? cinerea, *Engelm.* Branchlets and both sides of the almost entire leaves canescent, even when mature; berries very small, black and shining, very acid until after frost. — Rich bottom lands in the Mississippi Valley, Illinois, and Southward. [679]

3. V. cordifolia, *Michx.* Has the small berries black without bloom, the small seeds rounded above and with a prominent rhaphe. Unfit for cultivation.

3a. V. riparia, *Michx.* Leaves larger, usually incisely 3-lobed, the lobes long-pointed; panicles small, rather simple; berries larger and mostly with bloom; seeds larger, obtuse or somewhat obcordate and with an inconspicuous rhaphe. — May, earlier than *V. cordifolia*. Thickets and river-banks, from Vermont to Michigan and Illinois. Several varieties in cultivation: the most esteemed white one is the Taylor-Bullit Grape. The celebrated claret-colored Delaware Grape seems also to belong here.

From Botanical Observations in Southern Utah, No. 4, by Dr. C. C. Parry (Amer. Naturalist, Vol. IX. May, 1875).

30. Vitis Arizonica, *n. sp.* Young branchlets, leaves and inflorescence densely floccose-tomentose, adult naked or usually (at least on the nerves of the leaves) beset with short hairs; leaves (small) orbiculate, cordate, with a wide (sometimes very broad) sinus, acute, with irregular, sharp, often very pointed, rather small teeth; rarely 3–5-lobed with rounded sinuses; tendrils intermitting,[1] branched; fertile inflorescence and bunches of berries shorter than leaf; berries small or middle-sized (2–3½ lines in diameter); seeds mostly 2–3, usually obtuse with a small but prominent chalaza and more or less indistinct rhaphe. *Vitis æstivalis*, var. ? Gray, Pl. Wright, pt. 2, p. 27. Torrey, Pac. R. Rep. 7, Bot. p. 9. — Common along the streams of Arizona, where it was first collected by the botanists of the Mexican Boundary, and of some of the Pacific Railroad Expeditions; later by Dr. Palmer, who made an especial study of it and gathered numerous specimens in mature fruit; Dr. Parry's collections are from southwestern Utah. [269]

With some hesitation I venture to introduce a new species in this intricate genus, and especially in the *Cordifolia* group; but as this form cannot well be united with any of its allies, it will have to try and stand for itself. The forms belonging to the *Cordifolia* group are distinguished by their more or less entire leaves and small berries; they extend over the whole breadth of the continent from northeast to southwest, and are: *V. cordifolia*, with larger

[1] *Intermitting* tendrils we find in those species of *Vitis* where two leaves with opposed tendrils are succeeded by a third leaf without a tendril, and so on in succession; the ordinary occurrence in all our grape-vines, with the exception of *V. Labrusca* and its cultivated varieties; in these the tendrils are *continuous*; i. e., each leaf has a tendril opposed to it; all this only in well-grown canes. This character distinguishes at once all forms of *Vitis Labrusca*. *Branched* tendrils are found in all our species, with the exception of *V. vulpina*, which bears *simple* tendrils. [269]

[smaller], broadly dentate, glabrous leaves and smallest berries in larger bunches, rhaphe usually strongly developed on the top of the seed as a well-marked cord, — from New England to Missouri, Nebraska, and Texas; *V. riparia*, with larger, incisely dentate, usually sharply 3-lobed, glabrous leaves, larger berries in small bunches, rhaphe slightly visible on top of seed, — from Canada to the Rocky Mountains and to Texas; *V. Arizonica*, with smaller, broadly cordate, sharply dentate leaves, floccose at first, glabrous afterwards, middle-sized berries in small bunches, rhaphe more or less indistinct on top of seed; *V. Californica*, with middle-sized, narrowly cordate, broadly dentate, always tomentose or canescent leaves, small berries in large bunches, rhaphe invisible on the broad seed, — found only on the Pacific slope, from the Sacramento Valley southward.

The fruit of *V. Arizonica* belongs, like that of *V. riparia*, to the better class of American grapes; while that of the two others is scarcely edible, this is said to be quite luscious, and will in time no doubt be cultivated in a warmer climate. Dr. Palmer's seeds have germinated well with me, but the vines perished in the climate of St. Louis, after a lingering existence of several years. The seeds show a remarkable variability in form and markings, so as to weaken to some extent their specific value. I find them generally obtuse, but emarginate and even notched on top; the chalaza is small, but usually quite prominent and is narrowed upward into the rhaphe, which on the top of the seed becomes inconspicuous, or in some instances remains quite prominent.

Dr. Parry's specimens from southwestern Utah are distinguished from all the Arizona specimens I have seen, by having somewhat lobed leaves. Their sterile flowers exhibit the usual form, longer anthers on long straight filaments, which in the bud are inflexed; in the fertile flower-bud the stamens are shorter than the pistil, the filaments straight and scarcely as long as the short anthers, and after fecundation recurved. I could discover no difference in the condition of the pollen of both kinds of flowers. This seems to be the ordinary form of the fertile flowers in our wild species, and in some cultivated ones, while some other stocks bear fertile flowers with long stamens, thus constituting the incompletely polygamous character of our grape-vines; purely pistillate flowers I have never seen, and doubt whether they exist.

V. MISCELLANEOUS NOTES ON VITIS.

From Bulletin of the Torrey Botanical Club, Vol. VI. 1878–1879.

Vitis cordifolia, L., and *V. riparia, Michx.*,* are still mixed up in the opinion of many [233] of our botanists, and trouble them, whenever they are obliged to touch them. The observations made this spring have again confirmed my long-settled conviction of their absolute specific difference, and may help others to better distinguish them.

Vitis riparia was in bloom here in the last week in April, and in favorable localities (on the rocky, sun-exposed banks of the Mississippi,) even before the 20th of that month. *V. cordifolia* bloomed fully four weeks later, and even into this month of June, long after *Labrusca*, and a little before *Æstivalis*. As this spring was an unusually early one, it is better to compare their flowering with that of well-known trees; thus *Riparia* bloomed after the apple-tree, and about the time when the first garden roses and the first Acacia (*Robinia*) blossoms made their appearance; *Cordifolia* bloomed when the flowers of Ailantus exhaled their nauseous odor and Catalpa blossoms were just opening.

The young, half-grown leaf of *Riparia* is glossy shining (on the upper surface), and is supported by a pair of conspicuous, white, membranaceous stipules, oblong or linear-oblong, two or three lines in length; the mature leaf is scarcely wrinkled, and of a bright deep green color, and usually has a broad, at the base truncate, sinus.

The leaf of *Cordifolia* is always dull, even when young, perfectly smooth, and paler green, and its rounded short stipules are mostly less than one line in length; the sinus, though it may be wide, is always acute.

I need not repeat that the shape of the leaves in typical specimens is distinct enough, but that forms occur, which, without the help of other characters, it would be difficult to keep apart; and this made undoubtedly the great difficulty in the distinction of both species.

* A tabulation of the differences here enumerated is given by Millardet in La Vigne Américaine, Oct. 15, 1878, pp. 225, 226, and in Notes sur les Vignes Américaines, Bordeaux, 1881, p. 104. — Eds.

There is generally a hairy (rarely cottony, as in *Labrusca* and *Æstivalis*) pubescence on the under side of young leaves, especially along the ribs; more so in *Cordifolia*, less in the other species; in the former this pubescence sometimes remains throughout the season, and rarely even verges to the arachnoid down of *Æstivalis*.

In this neighborhood *Riparia* matures its fruit in July and August, further north in September, earlier than even *Æstivalis*; *Cordifolia* not before October.

Now, having distinguished the species, let us see about their geographical distribution. *Riparia* is the northern and western, *Cordifolia* the southern and eastern form; in the Middle or Central States they both occur together. I have found *Riparia* on the Great Lakes, on Niagara, on Lake George, and have it from Vermont; it is common in Missouri and Illinois, and extends to the Rocky Mountains of Wyoming, Colorado, and New Mexico. How far south of the Ohio it is found I have now no means of ascertaining. *V. cordifolia* is common throughout the Middle and Southern States, but I have seen no specimen north of New York, nor west of Missouri.

I may add that *V. Æstivalis* extends through the whole *Vitis* region of eastern North America, from New England to Texas, and from the Atlantic to the great plains, but not to [234] the mountains beyond. *V. Labrusca* is our most local species, being confined to the Alleghany Mountains and the region between them and the Atlantic, unknown in the Mississippi Valley or beyond. Whatever has been called so there, or in Louisiana or Texas, is a large and downy-leaved form of *Æstivalis*, always readily distinguished by its "intermittent" tendrils, while *Labrusca* has more or less "continuous" tendrils.

Will local botanists assist me to more accurately define the geographical limits of our species of *Vitis?* And may I request them to collect fertile flowers as well as sterile, the only ones found in most herbaria? — [June, 1878.]

In the June number of last year I have enumerated some of the characters which distin- [310] guish *Vitis riparia* from *Cordifolia*. I can now confirm all I have said there. Our present spring being later than the very precocious one of last year, *Riparia* bloomed about May 10th and *Cordifolia* begins now, May 27, to open.

Another, and a very valuable, character to distinguish *Riparia* not only from *Cordifolia*, but from all other species of *Vitis*, has been indicated by Prof. Millardet of Bordeaux, and is fully confirmed by my observations made on specimens from all parts of their geographical area. [311]

The dissepiments or diaphragms, as they are called, which at each node interrupt the medullary tissue, and which are best studied in vines of the previous year, are in *Riparia* very thin, only $\frac{1}{8}$ to $\frac{1}{4}$ of a line in thickness, while in *Cordifolia* they are $\frac{1}{2}$–1 line thick, and in *Æstivalis* a little thicker yet.

Pursuing these investigations through all the species of *Vitis* attainable, I find that the Rocky Mountain *Vitis* and that from Lake Superior have been correctly referred to *Riparia*, while *V. Arizonica*, about the relationship of which I had some doubts, is certainly distinct from *Riparia*.

All true *Vitis* have such diaphragms at each node, while all the species of *Ampelopsis* and of *Cissus* are destitute of them. But the startling fact appears that *V. vulpina* of the South in this character is different from all other *Vitis* species and affiliates with *Cissus*, its pith being continuous and not interrupted.

V. cordifolia, thus completely separated from *Riparia*, approaches, strange as it may seem, close to *Æstivalis* in the character of the diaphragm, in its period of flowering, and even in its seeds, and the connection seems to be made by that western entire-leaved and small and black-fruited form of *Æstivalis*, which I have distinguished as *Cinerea*, to which downy-leaved forms of *Cordifolia* approach almost too closely.

All the species of *Vitis* contain in their foliage more or less of a fragrant principle, most proba-

bly Cumarin, which the dried leaves retain with such tenacity, that even after fifty years in the herbarium they exhale this very distinct odor. In *Cordifolia* I find it much more strongly developed than in any other species.

From the Transactions of the St. Louis Academy of Science (Proceedings), Vol. IV. 1880.

Wild Grapes. — One of our most important grapes, *V. Labrusca*, or the Northern Fox grape, does not [xliv] cross the Alleghanies, being a native of the eastern slope. This grape has been improved by cultivation and has given rise to all our larger-berried varieties, as Isabella, Catawba, Concord, etc.

V. æstivalis, or Summer grape, is abundant throughout a great part of the United States, but does not grow wild west of the woods of the Mississippi Valley. This grape is the base of the Virginia Seedling, the Herbemont, and other cultivated varieties.

V. riparia of Michaux, also known in this neighborhood as the June grape, and the River-bank grape. Grows farther north than any of the others, being found at Lake Superior, and, skipping the plains, is found on the eastern slope of the Rocky Mountains. It also grows in Texas. But in the East it does not seem to occur south of Pennsylvania. It is an early grape, and sweet and very palatable.

V. cordifolia, or Winter grape, does not grow north of New York and Central Illinois, but at Washington and Philadelphia it is the most common grape. The trunk of this grape is the largest of all, being sometimes from eight to twelve inches in diameter, at least in the river bottoms of the Mississippi Valley, and climbing the highest trees; its fruit is rather disagreeable.

The French are now obtaining from the woods in this vicinity a large number of cuttings and an immense quantity of seed, principally of *V. riparia*, but also of other species, having discarded the *Labrusca* entirely. As the *Labrusca* does not grow wild in this region, there is no danger of getting here hybrid varieties. Our wild grapes are used in France as stocks to graft their own vines on, in the expectation that the American stock will resist the destruction of the phylloxera, which has made such sad havoc among their grape-vines. It has already destroyed one entire fourth of the French vineyards, thereby crippling materially the prosperity of the country.

From the Botanical Gazette, Vol. VIII. 1883.

The *Vitis palmata* of Vahl has been cultivated in the Paris Botanic Garden for a century or more, and has [254] thence found its way into other European gardens without, as it seems, attracting the attention of botanists. On the banks of rivers in Illinois, some eighty or ninety years ago, Michaux discovered this *Vitis*, which he, with the very scanty herbarium specimens before him, stowed away with his *Vitis riparia*, leaving, however, with it his original label: "*Vitis rubra, abonde sur les rivières aux Illinois*," but never even mentioning the name in his Flora. When, twenty-six years ago, I studied Michaux's collections in the Jardin des Plantes, I was struck with the peculiarity of the specimens, especially with that which is preserved in the General Herbarium;[2] its seeds were so odd that I almost suspected a confusion. In this country it seems to have remained quite unknown; in Torrey and Gray's Flora it is suggested that it might be a form of *V. æstivalis*. Vahl's statement that it came from Virginia is, of course, erroneous, but not more so than many other American localities published in those, geographically, dark ages.

Mr. H. Eggert has had the good fortune to re-discover this species last fall, and, collecting it again this summer, has furnished observations and specimens which permit me to complete the history of this long neglected plant.

Vitis palmata, *Vahl.* A vigorous climber with red branches (and often also red petioles), young shoots angular and ribbed, older ones losing the bark in large flakes; diaphragms rather thick; stipules very short, rounded, early deciduous; leaves smooth, glabrous (or on the nerves beneath with short, straight hairs), dull and rather dusky green, cordate with a broad sinus, mostly deeply 3- or sometimes 5-lobed, lobes when long, widest in the middle, contracted at base and mostly slenderly caudate-acuminate, with few coarse teeth; flowering racemes compound, long peduncled; berries black without any bloom, rather small (4 to 5 lines in diameter); seeds large for the size of the fruit, slightly notched on top, single, and then nearly globose, or in twos, when they are hemispherical and very flat on the ventral side; beak very short, chalaza narrow, elongated, groove without any visible rhaphe. [255]

Michaux found it abundant on river banks in Illinois, but he may have confounded it with *V. riparia*, which is very abundant there. Mr. Eggert collected it in Missouri, on the Mississippi, in low bottom land, opposite Alton,

[2] I may also say that in hunting through Michaux's *Vitis*, I came across a well characterized specimen of *V. rupestris*, also preserved in that sheet of *V. riparia*. As Michaux never botanized west of the Mississippi, where *V. rupestris* is found, from Missouri to Texas, it remained a question where he could have obtained that specimen, which had no label attached to it, until a few years ago Dr. Gattinger discovered the species on sand-bars in the Cumberland River near Nashville, a region well explored by Michaux.

not far above the mouth of the Missouri River, where it is found with *V. riparia*, flowering later than any other of our species here, in this very late season apparently not before the 15th or 20th of June ; it matures in October, and the berries remain on the vine till November and later; their taste is sweet, without any disagreeable admixture. The plant, like *V. riparia*, grows readily from cuttings.

The species resembles *V. riparia* in the broad sinus of the leaves and the form of the seeds, but it is distinguished by the deep red color of the stems, which are angular when young, not terete, the thick diaphragms, the very small stipules, the dull, dusky color of the leaves and the form of their lobes, the bloomless berries, the large seed, and the late flowering period. With *V. cordifolia* it has very little in common, except the thick diaphragm and the bloomless berries. The absence of a prominent rhaphe on the seeds distinguishes it at once, and no other species could possibly be confounded with it.

VI. ON DISEASES OF THE GRAPE.*

From the Transactions of the St. Louis Academy of Science (Proceedings), Vol. II. 1861.

Dr. Engelmann exhibited specimens and numerous drawings of two species of fungi, which infest our vine- [165] yards to such an extent as to materially diminish the crop and influence the culture of the grape, at least that of the Catawba, in our region. The first is a species of *Botrytis*, and perhaps the same as Berkeley's *B. viticola* (very near *B. acinorum*, Pers. ?). It makes its appearance in the latter part of June, on the lower downy surface of the leaves of the Catawba variety of *Vitis Labrusca* (the only one extensively cultivated here), forming irregular confluent spots. The horizontal fibres of the mycelium have a diameter of 0.005 line, finer and whiter than the hair of the down with which they are interwoven; the erect fructiferous stems, about 0.3–0.4 line high, and a little thicker than the horizontal fibres, bear numerous horizontal branches, upwards gradually shorter, the last divisions of which form very short pedicels, always 2 or 3 together, bearing oblong or oval, very deciduous pores, 0.008–0.011 line in the longer diameter. About the same time the mildew appears on the pedicels, and often also on the young berries when they are of the size of small peas or smaller; Dr. E. never saw it on full-grown berries. Those attached on their surface or on their pedicels soon fall off ; but the most material damage is done by the mildew infesting the leaves, whereupon the greater part of the berries will gradually turn yellowish-brown at their base, shrivel from that point, assume a club shape, and at last dry up entirely, usually remaining adherent to the withered racemes. This he designated as the *Brown Rot.*

The second kind of rot, the *Black Rot,* is brought on by a very different fungus, which he believed was undescribed by botanists. It evidently belonged near Ehrenberg's genus *Næmaspora*, and ought to bear the name *ampelicida.* It makes its appearance only on nearly full-grown berries, exhibiting in the first stage a discolored spot on the side, but never at the base of the berry, about 2 lines in diameter, with a dark dot in the centre. This spot soon becomes light-brown and remains so, while the surrounding part of the berry gets darker, and exhibits a rough or (under a magnifier) pustulous surface ; gradually now, the berry shrivels up and turns black. The individual fungi are little spherical bodies (0.07–0.10 line in diameter), formed under the surface in large numbers, which growing, elevate, and at last burst the epidermis, then open at their apex by a small jagged hole, and shrivelling with the berry, eject a more or less curled or twisted thread, which, moistened, becomes gelatinous, and shows the innumerable oval sporules (0.004–0.005 line long), each imbedded in its coat of mucilage.

These kinds of fungi are found either on distinct vines, or sometimes also on the same ; they are very rarely seen on grapes cultivated in yards and on houses, but are very common, not to say universal, in our [166] gardens and vineyards, in some seasons more so than in others. It is said that vineyards farther north, e. g., in Northern Illinois, are free from these pests.

Whether other diseases assist in the destruction of the grape, as wine-growers will have it, he cannot, from his own experience determine. He has never seen the *Erysiphe*, which is so destructive to the gooseberry, and to vines in graperies, on grapes cultivated in the open ground.

* This communication is quoted verbatim by Hon. Isidor Bush, in Proc. Amer. Pomolog. Soc., Session of 1879, pp. 17–19. — Eds.

OAK AND GRAPE FUNGI.

Some fifteen years ago I presented to the Academy an account, with microscopic drawings, of two of [ccxv] the most destructive fungi of our grape-vines. One of them is the "Mildew," a downy white coating on the under side of the leaves, the peduncles of the just-forming fruit, and the very young berries themselves, causing the leaves to wither and the young fruit to shrivel and fall off. That fungus was classed as *Botrytis*, and is now known as one of the *Peronosporæ*, another one of which constitutes the potato disease. This appears at the time of flowering or soon afterwards.

The second, and I believe, more common and destructive fungus, attacks the full-grown, yet green berries, and destroys them. After penetrating the tissue with its mycelium, it appears on the surface of the berry as a minute discolored spot, always on the side, which enlarges, and produces black pustules visible to the naked eye, which at last kill the berry and cause it to dry up, emitting at the same time their millions of spores. This fungus, described as *Phoma viticola*, makes its appearance in the latter part of July and in August.

I exhibit to you to-day another grape fungus, which is new to me, and seems to have been unknown to those grape growers with whom I have conversed. A yellowish-brown spot, a few lines in diameter, appears on the leaf, on the upper side of which a good eye, or a glass, will discover a number of very minute black specks. These are little globules, 0.13–0.15 line in diameter, which have a little opening at the top from which they emit their microscopical spores by the thousand. These oblong or oval spores are one-celled, and have a diameter of 0.013 or 0.014 line.

This fungus belongs to the family of *Coniomycetes*, and to that group which live on decaying vegetable matter. These yellow spots are the decaying substance, but their vitality has been destroyed by the mycelium of the fungus; those still more minute threads which penetrate the tissue in every direction, exhaust and kill it, and thus form what we may call their fruit, the perithecia, which when mature emit the spores. It belongs to the genus *Depazea*, of which many species, mostly leaf-inhabiting, are described, and it may be called *Depazea Labruscæ* — Grape-leaf spot.

This parasite makes its appearance earlier than the others mentioned above, viz., just before and during [ccxvi] the flowering period, and attacks, as far as known, only the leaves, which, where abundant, it kills, and thus cripples the plant; it is also found, though rarely, on petioles and peduncles. Dr. Wislizenus informs me that it attacks indiscriminately all grape varieties, but more the lower leaves of a stock than the upper ones; while he finds the phylloxera galls on the uppermost not yet full-grown foliage.*

. . . . . .

It is necessary to remind you, that though we know a great many forms of fungi, we know the life history of only a very few. It is certain of some, and very probable of many, that they constitute transition states of other more highly developed fungi, and only when we shall have become acquainted with the different phases of their development, shall we be able to appreciate their importance and counteract, perhaps, their destructive action. — l. c. vol. iii. 1878, (Read 1876).

From the Bushberg Catalogue, 3d ed., St. Louis, 1883.

The diseases of the grape-vines are principally occasioned by animal or vegetable parasites. I leave [47 (15)] others, who are more conversant with the subject, to treat of the former, and will merely state here that our species have all grown up with the phylloxera, and would have long ago been extinguished, or rather never could have lived, if that insect had such power over them; but they as well as the insect live on, the latter having no other nourishment than the grape-vines and their roots: you may call it an accommodation between them.

More important for us in America are the fungus diseases, which do our grape crops more harm than the phylloxera. It is said that in Europe they have discovered over 200 kinds of fungi which live on the different [48 (15)] parts of vines, but fortunately only a few of them are really injurious. These are, above all, the mildew of the leaves and the black rot of the berries. In Europe they have, besides our mildew, which has lately been introduced, the *Oïdium* and the *Anthracnose*.

The *Mildew*, *Peronospora viticola*, appears in frost-like white spots on the under side of the leaves, hairy as well as glabrous ones, here in Missouri generally from the beginning of June, fostered by the sultry and damp or wet weather usual at that season; in the Eastern States it seems to come on later in summer and in the fall. Though most common on the leaves, it sometimes also infests the petioles of the leaves, the stems of the bunches, and the very young berries. But, even if it does not attack the latter, the effect on the leaves alone, which turn brown in spots and are eventually partially or completely killed, destroys the fruit, the berries shrivelling *from the base*, turning light brown without falling off. This is here sometimes termed *Brown Rot*.

* Two paragraphs, referring to *Septoria Querci*, are omitted here, but will be found on p. 410. — Eds.

The fungus at first pervades the cellular tissue of the leaf; then, a few days later, the minute fungus stems protrude through the stomata (breathing pores) of the lower surface, forming little upright branching plantlets, which might be compared to a miniature spruce tree, singly not visible to the naked eye; they bear at the end of the branchlets the summer spores (*conidia*), which mature, are discharged, spread by wind or otherwise, and, when moistened, germinate with astonishing rapidity. Late in the season the fungus produces what are called the resting spores (oospores) in the interior of the leaf-tissues, and, while the others propagate the parasite in summer, these larger and more enduring ones keep alive through winter and insure its growth in the following summer. Thus it is seen that the dead mildewed leaves, containing the resting spores, really do preserve the germs for the next season's mildew. These leaves ought to be destroyed by carefully gathering and burning them, or by burying them *deeply* in the ground. The direct destruction of the fungus has been often attempted, and by different means, especially by sulphur-sprinkling, but without any marked effect; a dry spell of weather, however, arrests it most effectually for the time being.*

The *Peronospora* has since 1878 made its appearance in Europe, — like the phylloxera, accidentally introduced from this country, — and has added another terrible infliction on the wine-growers there, which threatens to be worse than the *Oïdium*, which years ago used to decimate the grape crops of Europe.

A few words about this *Oïdium* may be in place here. This is a mildew-like fungus which appears on the *outside* of the *upper* surface of the vine-leaves, and bears its fewer spores on smaller, not much branched, stemlets; it destroys the vitality of the leaves, and with it the crop, just as our mildew does. Its resting spores are unknown and with its life-history we are not so well acquainted, but we know that sulphur sprinkled over the leaves will destroy it. It made its first appearance, as far as it is known, about 1845, in graperies at Margate, near London, and spread rapidly and destructively over a great part of Europe and the islands, especially Madeira, where the grape culture was almost annihilated by it; but it seems to be now less common or less injurious than it was years ago, and may possibly have run its course, just as other epidemics are apt to do. It is unknown where it originally came from; some suppose that it originated in America, but it has never appeared here in the form under which it is known in Europe; whether in another form, is still questionable among our best mycologists; at all events we have thus far only one destructive form of mildew here, the *Peronospora*.

The second great fungus pest of our vineyards is the *Black Rot, Phoma uvicola*. On the berries but never on the leaves or stems, generally about the time that they are full grown, in July or August, very rarely on half-grown berries in June, a light brown spot with a darker central point is observed on the side and not near the stem; this spot spreads, and darker, shining nodules or pustules, plainly visible with the naked eye, begin to protrude above the epidermis; at last the whole berry shrivels up, turns bluish-black and the pustules roughen the surface, and each one opening at its top emits a whitish worm-like thread, which consists of innumerable spores glued together with a mucilaginous coating. In this condition the spores are inert, but rain will dissolve the mucilage and liberate and wash down the spores, or they will with the dead berries fall to the ground. What then becomes of them, whether they enter the soil, or how they propagate the fungus, is as yet unknown. At all events it seems advisable to gather all the affected berries, if such a thing can be done, and destroy them.

In Europe they have another fungus disease of the grape, called in Germany *Brenner*, in France *Anthracnose*, and described under the name of *Sphaceloma ampelinum*, which by some authorities has been supposed to be another form of development of our Black Rot, above described; this, however, seems very doubtful. We have, as it seems, never had the *Sphaceloma*, nor they the *Phoma*. The former attacks all the green parts, leaves, young stems, or green berries, and forms open wounds which might be compared to ulcers, while our *Phoma* is restricted, as far as known, only to green berries, without breaking up the tissues or forming ulcers. The *Sphaceloma* seems to be an old disease in Europe, known already in the last century. Mycologists are now carefully studying these questions.

* The use of sulphur, or crude carbolic acid mixed with quicklime, as a manure, was suggested by Engelmann in 1879. Proceedings St. Louis Acad. vol. iv. p. xxxix. — Eds.

X.

PAPERS ON EUPHORBIACEÆ.

I. EUPHORBIACEÆ OF THE MEXICAN BOUNDARY.

From Report on the Boundary Survey, Vol. II., Part 2, Botany, by John Torrey, 1859.

§ I. ANISOPHYLLUM.

Euphorbia petaloidea : patulo-ramosissima ; foliis oblongis oblongo-linearibus linearibusve retusis mu- [185] cronatis; glandulis albo-appendiculatis ; seminibus lævibus.

α. Nicolletii: foliis stylisque brevioribus ; anthodiis cymulosis ; seminibus ovatis.

β. intermedia : foliis angustioribus ; stylis longioribus ; anthodiis cymulosis.

γ. Nuttallii : foliis linearibus; anthodiis alaribus ; appendiculis orbiculatis ; stylis elongatis, seminibus subglobosis. *E. arenaria*, Nutt. Pl. Arkans. p. 171, non HBK.

δ. flagelliformis : priori similis, sed appendiculi minimi, styli breves. Of these varieties *α.* and *β.* have not been found within the districts explored by the Boundary Commission, but they probably occur there. The var. *γ.* is common in Texas. Wright's 1826, belongs to var. *δ.*, a New Mexican form.

Euphorbia serpens, *HBK.* *E. herniarioides*, Nutt. l. c. p. 171. In the southwestern parts of North [186] America (abundant on the Mexican boundary line) and throughout Central and South America, but not in the eastern States. *E. microphylla*, Roth, from India, is the same plant.

Euphorbia revoluta, *n. sp.* : erecto-patula ; foliis linearibus revolutis obtusis basi subæqualibus, stipulis setaceis ; anthodiis alaribus ; glandulis anguste appendiculatis ; stylis recurvis apice bifidis ; capsula acute angulata seminibus angustis acute angulatis transverse rugosis. (Gravelly hills near Rock Creek ; *Bigelow.* On the Rio Grande ; *Wright*, No. 1830.) New Mexico ; *Fendler*, No. 789. Very slender, 4–5 inches high ; leaves 6–10 lines long and ½ line wide. Habit like a small slender *E. petaloidea*, but styles and seeds very different.

Euphorbia polycarpa, *Benth. Bot. Sulph. p.* 50. Dry soils near San Diego, California ; *Parry, Schott.* Banks of the Gila ; *Major Emory.* Sonora; *Wright*, No. 1854. This is a very variable plant, if all the forms which I refer to here really belong to it. Seeds smooth or undulate, appendages none, or small or large ; plant smooth or pubescent (and then always with short patulous hairs). Collected by all the botanists from the Upper Gila to San Diego. The only species of the section *Anisophyllum* which, so far as I know, has both smooth and pubescent forms, with the exception of *E. hypericifolia*.

Euphorbia Arizonica, *n. sp.*: erecto-patula ; foliis e basi lata subæquali ovatis obtusis pilosis ; stipulis inconspicuis ; anthodiis alaribus longius pedunculatis ; appendicibus glandula purpurea multo majoribus obovatis tubo turbinato postice fisso brevioribus ; stylis erectis ad medium bifidis ovario puberulo longioribus, stigmatibus filiformibus ; capsula pilosa ; seminibus rugoso-verrucosis ad angulos acutos crenulatis. Sierra Yanos, Sonora, July ; *Schott.* Stems 4–5 inches high ; leaves 3–4 lines long, 2½–3 lines wide. Seed very small, involucrum with the appendage 1½ line in diameter.

Euphorbia pediculifera, *n. sp.* : procumbens, cinereo-pubescens ; foliis ovatis obtusiusculis ; stipulis e basi lata lanceolatis ; glomerulis parvifloris in ramulis alternis terminalibus ; involucris hemisphæricis ; glandulis magnis ; appendicibus transversis crenatis ; stylis patulis pubescentibus ad basin fere bifidis ; stigmatibus divaricatis ; capsula acute angulata pubescente, seminibus compressis angulatis sulcis 4 profundis transverse incisis. Sonora ; *Wright* (No. 1848), *Schott.* Spreading 6–12 inches. Leaves 3–4 lines long, oblique. Involucrum large. Seeds 0.7 line long, deeply 5-lobed, similar to some insects.

EUPHORBIA FENDLERI, *Torr. & Gray, Bot. Pope's Rep. p.* 19. *E. rupicola*, Scheele in Linnæa, 22, p. 153, non Boiss. Common in New Mexico and Western Texas; *Lindheimer, Wright, Bigelow.* Sonora; *Thurber.* Variable in the form of the leaves and the shape or presence of the appendages.

EUPHORBIA ALBOMARGINATA, *Torr. & Gray, l. c. p.* 18. Common in the whole region between Western Texas and the Great Colorado, and southward into Mexico. It is No. 330 of Drummond's second Texan Collection.

EUPHORBIA CINERASCENS, *n. sp.*: erecto-patula s. subdecumbens, pubescenti-canescens; foliis e basi lata obliqua ovatis s. suborbiculatis obtusis supra glabratis; stipulis lanceolatis minutis mox deciduis; glomerulis lateralibus; involucris canis; glandulis (plerumque purpureis) angustissimis marginatis; stylis brevibus pilosis; capsula acute angulata cana; seminibus ovatis acute angulatis læviusculis. On the Rio Grande; *Wright.* Chihuahua and Sonora; *Thurber.* Bishop's Hill, near Monterey, Mexico; *Gregg.*

β. APPENDICULATA: foliis utrumque cinereis; appendicibus majoribus truncatis crenulatis; stigmatibus longioribus. San Felipe, California; *Dr. Le Conte, Thurber;* and San Gabriel; *Bigelow.* Stem 4–6 inches high; rounded leaves, often tawny red, 1½–2 lines long; flowers few. Mr. Thurber informs us that this plant is called [187] *Yerba de la Golondrina* in Sonora. The Mexicans believe it to be a certain cure for the bite of a rattlesnake and other poisonous animals. The bruised fresh plant or the dried, steeped in wine, is applied to the wound. A tincture of the plant is sometimes kept in the apothecaries' shops of that country. According to Dr. Gregg, the name *Golondrina* is applied to all the prostrate *Euphorbiæ.*

EUPHORBIA INÆQUILATERA, *Sonder in Linnæa, 23, p.* 105. I cannot distinguish from this plant of the Cape of Good Hope a species of the plains of Nebraska, Kansas, and Texas, and which extends into New Mexico, California, and Oregon. There it has been collected since the explorations of *Nicollet* and *Fremont* by almost every traveller (e. g., *Fendler*, 791, 795, 803; *Wright*, 666, 1823, in part, 1846). The same plant has been sent from Florida by *Blodgett* and *Chapman*, is found on the West India Islands, is undoubtedly the *E. Nilagirica*, Miq., of India, and has also been observed in New Holland; but it seems unknown in other States east of the Mississippi.

EUPHORBIA GLYPTOSPERMA, *n. sp.*: erecto-patula seu demum decumbens; foliis e basi valde obliqua (latere inferiore producta) æquilatis oblongis s. oblongo-linearibus obtusis versus apicem subserratis s. integriusculis; stipulis setaceis laciniatis, anthodiis alaribus demum in glomerulos laxos laterales confertis; appendiculis brevibus integris seu crenatis; stylis brevibus apice bilobis, stigmatibus subglobosis; seminibus ovatis argute rugosis ad angulos acutos crenatis. *E. polygonifolia*, Hook. Fl. Bor.-Am. fide spec. auctoris, non Linn.

β. TENERRIMA: foliis parvulis angustis apice vix crenulatis; involucri minuti glandulis vix seu non appendiculatis. On the Rio Grande; also on the Arkansas, and extending to the Upper Missouri. (No. 1853, 1855, and 1856, *Wright.*) From a few inches to a foot high. The larger northern forms have leaves 3 to 6 lines long and 1 to 2 lines wide. In β. the leaves are 1 to 3 lines long and ½ to 1 line wide; involucrum in the latter only 0.3 line long. Seed very sharply cross-ribbed, similar to that of *E. prostrata*, and notched at the angles.

EUPHORBIA STICTOSPORA, *n. sp.*: erecto-patula, foliis e basi obliqua subcordata orbiculatis seu ovatis argute serratis supra subnudis; stipulis subulatis ciliatis; glomerulis lateralibus sessilibus; glandulis angustis appendiculatis; stylis ovario pubero brevioribus patulis indivisis; stigmatibus 3 capitatis; capsula puberula; seminibus angustis acute angulatis exsculpto-punctatis. From Kansas (*Fendler*, 798), to Santa Fé (*Fendler*, 797) and Doña Ana (*Wright*, 59), New Mexico, and Corallitas, Chihuahua; *Thurber.* Stem 3–6 inches high. Leaves 2–4 lines long; apparently near *E. prostrata*, but styles and seeds very different.

EUPHORBIA PROSTRATA, *Ait.* This variable and often mistaken species is found from Western Louisiana (*Dr. Hale*) to Texas; (*Lindheimer*, 533); (*Berlandier*, 1100, 2530); (*Wright*, 1848 in part, 1855 in part). It seems to be a common plant in the West India Islands, Mexico, and South America. It occurs in Africa and India. *Euphorbia tenella*, HBK., and *E. callibrichoides*, HBK., are forms of the same species, which can always be recognized by the ciliate angles of the capsule and the sharply rugose seeds, notched at the angles.

EUPHORBIA DIOICA, HBK. (*E. anceps*, Benth. *E. callibrichoides*, Schauer, etc.), a common and very variable plant of Mexico, Central America, and the West India Islands; has been collected by Dr. Antisell on the upper Rio Grande.

VAR.? INDIVISA, distinguished by the annual root, the less coriaceous, less oblique and less distichous leaves, the more scattered involucra, and the undivided styles; has been found near the Copper Mines, New Mexico, by Mr. Wright (No. 1845), and in Sonora by Mr. Thurber (No. 963).

EUPHORBIA SERRULA, *n. sp.*: patula seu decumbens; caule patenter piloso; foliis e basi valde obli- [188] quo obtusiuscula seu subcordata oblongis sæpe falcatis obtusis argute grosseque serratis, subtus pilosis; stipulis lanceolatis laciniatis; glomerulis lateralibus appendicibus angustis integris seu crenulatis; stylis ovario glabro brevioribus patulis ad basim fere bifidis; seminibus ovatis lævibus costato-angulatis. Western Texas and New Mexico (No. 658, 1843 and 1844, *Wright.* No. 796 and 804, *Fendler*). Stems 4–6 inches long. Leaves 3–5 lines long, 1–3

lines broad, sharply and coarsely serrate; seeds larger than in all the foregoing species, 0.8 line long, remarkably angled.

EUPHORBIA VILLIFERA, *Scheele in Linnæa, 22, p. 153.* Western Texas; *Berlandier,* 2084; *Lindheimer,* 530; *Wright, Thurber.* In various parts of Mexico; *Gregg.* Root annual, stems erect, often a foot high.

EUPHORBIA HYPERICIFOLIA, *Linn. Sp.* 1, *p.* 454. New Mexico; *Wright* (No. 1842 in part). Chihuahua; *Thurber.* The true Linnæan plant probably comes from the West Indies and other tropical countries, and has also been sent from Florida by Dr. Chapman. It is distinguished by smaller anthodia, generally disposed in denser clusters, smaller capsules, and smaller, paler seeds. The common North American form, which has also been collected abundantly along the boundary, has larger and more scattered anthodia, larger capsules and larger blackish seeds, and may be distinguished as var. *communis*, as it seems to be the more common form throughout the warmer countries around the whole globe.

EUPHORBIA PILULIFERA, *Linn.* β. DISCOLOR: diffusa; foliis e basi valde obliqua ovatis subrhomboideis acutiusculis serratis, purpureo-maculatis, stipulis subulatis, capsula parvula pilosa, seminibus minutis ovatis acutis undulato-tuberculatis. Sonora; *Thurber. Wright,* No. 1842, in part. Mr. Blodgett found it in Florida. Stems ½–1 foot long. Leaves 1–1½ inch long; differs in shape and color of leaves from the usual forms of *E. pilulifera*; hair of the stem, as in all forms of this species, yellow and jointed; involucre only ½ line long; heads 3–4 lines in diameter; seed scarcely more than ⅓ line long.

EUPHORBIA CAPITELLATA, *n. sp.*: annua, erectiuscula seu demum diffusa; caulibus elongatis puberulis, foliis e basi valde obliqua oblongo linearibus submudis argute serrulatis mucronatis; stipulis lanceolatis laceris; glomerulis densifloris terminalibus fere aphyllis; involucri glandulis longius stipitatis, appendiculis orbiculatis s. late obovatis integris; stylis ovario hirto longioribus ad medium bifidis; stigmatibus filiformibus divaricatis; capsula puberula; seminibus ovatis acutatis angulatis rugoso-tuberculatis. Valleys at San Bernardino, Sonora; *Wright* (No. 1849). Stems 6–10 inches long; leaves 6–8 lines long, 2 lines wide; heads white, showy, 4–6 lines in diameter.

EUPHORBIA PYCNANTHEMA, *n. sp.*: perennis, erecto-patula, canescente-pubescens; foliis e basi lata obliqua cordata ovatis s. oblongis obtusiusculis sæpe mucronulatis integris s. subserrulatis, scabris; stipulis lanceolatis fissis; glomerulis terminalibus multifloris quasi involucratis; involucris pilosulis (primariis) late orbiculato-appendiculatis seu (secundariis) submudis; stylis fere ad basim fissis patulis; stigmatibus divaricatis clavellatis; capsula subglobosa pubescente; seminibus acute angulatis transverse rugulosis punctatisque. Mountain sides near Lake Santa Maria, Chihuahua; *Wright.* Numerous stems 6 inches high, from a thick ligneous root; leaves 4–5 lines long. General appearance of a small labiate plant with terminal involucrate heads. Similar in many respects to the last, but more erect, more hairy, leaves shorter. Remarkable for the different involucres on the same head, reminding one of *Hydrangea* or some *Umbellifera.*

EUPHORBIA LATA. *E. dilatata,* Torr. & Gray, Bot. Pope's Rep. p. 19; non Hochst. in Richard. Flor. [189] Abyssin. Western Texas, San Pedro; *Wright,* No. 1841. On the Cimaron; *Fendler,* No. 794. Eagle Springs; *Bigelow.*

EUPHORBIA ACUTA, *n. sp.*: perennis, multicaulis, erecta, foliosa, hirsuta; foliis e basi obtusa subæquali lanceolatis acutatis cartilagineo-mucronatis supra nudis; stipulis filiformibus mox deciduis; anthodiis versus caulis apicem alaribus s. pseudoaxillaribus sparsis; involucris hemisphæricis appendicibus truncatis crenatis lobatisve; stylis patulis ultra medium bilobis, ovario cano longioribus capsula cana; seminibus subcubicis acutis acute angulatis lævibus. Stony prairies Western Texas, along the San Pedro and Pecos rivers, &c.; *Bigelow, Schott.* (No. 1739 and 1749, *Wright.*) Stems ½–1 foot high; stiff rigid, leaves 6–10 lines long, 3–6 lines wide, well characterized by the very acute point; seeds 1 line long.

EUPHORBIA ANGUSTA, *n. sp.*: perennis, erecta, elatior, rigida; foliis lanceolato-linearibus basi acuta subæqualibus acutis integris demum glabratis; stipulis subulatis minutis decidnis; anthodiis pseudoaxillaribus sparsis; appendicibus truncatis crenatis sæpe bilobis erectis; stylis brevibus erectis apice bilobis; capsula cana acutangula; seminibus ovato-cubicis acutangulis transverse rugosis foveolatis. In rocky places Western Texas; *Lindheimer,* No. 69; *Wright,* No. 1828. On the Rio Grande; *Schott.* Erect, 6–15 inches high; several stems form a large black perennial root, with few or numerous elongated branches; leaves few, 6–15 lines long, 1–2 lines wide. Seeds 0.8 line long, strongly marked.

EUPHORBIA FLORIDA, *n. sp.*: annua, erecta, patulo-ramosa, glaberrima; foliis lanceolato-linearibus seu linearibus in petiolis attenuatis serrulatis mucronatis; stipulis lineari-subulatis sæpe 2–3-fidis; involucris alaribus in cymulas terminales laxas congestis; pedunculis petiolum longe superantibus; lobis involucri ovatis acutis seu acuminatis ciliatis seu rarius laceris; appendicibus magnis (involucro ipso majoribus) orbiculatis seu ovatis petaloideis integris; stylis ovarium æquantibus seu superantibus basi coalitis ad medium seu ultra bifidis; stigmatibus filiformibus; capsula obtuse angulata; seminibus subcubicis acute angulatis lævibus transverse 2-costatis. Sonora; *Wright* (No.

1829), *Thurber, Schott.* Stem ½–1 foot high; leaves 12–18 lines long, 1–1½ line broad; margin revolute, and serratures thereby often invisible. Involucre with large bright white appendages, 3 lines in diameter.

EUPHORBIA TRACHYSPERMA, *n. sp.*: annua, erecta, glaberrima; foliis e basi subæquali obtusa seu angustata oblongo-lanceolatis serratis mucronatis; stipulis filiformibus seu subulatis setaceo-fissis; anthodiis alaribus demum in cymulas paucifloras terminales s. laterales confertis; appendicibus angustis albis; stylis ultra medium bifidis; capsula obtusangula; seminibus subcubicis faciebus læviusculis, angulis acutis crenatis asperatis. San Pedro; Sonora; *Wright*, No. 1832. Slender, erect, about 1 foot high, branches erect, few; leaves 9–12 lines long, 2–3 lines broad; seed 1 line long.

EUPHORBIA EXSTIPULATA, *n. sp.*: annua, erecto-patula, ramosa, glabriuscula seu minute sparsimque aspera; foliis lanceolatis seu lanceolato-linearibus argute serratis basi æquali in petiolem brevem angustatis; stipulis submullis s. glanduliformibus; anthodiis alaribus solitariis; pedunculis petiolo brevioribus; appendicibus anticis plerumque 2-lobatis, posticis majoribus 4-lobatis; stylis ovarium ad angulos scabrum æquantibus, profunde bipartitis; stigmatibus filiformibus; seminibus magnis subcubicis verrucosis et transverse 2–3-costatis. Western Texas; *Wright* (1833 and 1838). New Mexico; *Fendler* (No. 790). Sonora; *Thurber, Bigelow, Parry.* Stem about 6 inches high; leaves about 1 inch long, 1–2, rarely 3 lines wide, sometimes not absolutely opposite, but a little separate; seed 1 line long, with thick cross-ribs. A transition form to the next sections.

§ II. ZYGOPHYLLÆ.

EUPHORBIA HEXAGONA, *Nutt. in Spreng. Syst.* 3, *p.* 791. *E. heterantha*, Nutt. in Trans. Amer. Phil. Soc. [190] (n. ser.) 5, p. 173. Rio Coleto, Texas; *Thurber.* "Many years ago Mr. Nuttall gave me specimens of this plant, named *E. hexagona.* Part of these were sent to Sprengel, who first published a description of the species in the work quoted. Eight years afterwards Mr. N. described the plant under another name. It is remarkable for being polygamous; most of the involucres containing only male flowers." — *Torrey*, MSS.

EUPHORBIA BILOBATA, *n. sp.*: annua, erecta, gracilis; foliis oppositis breviter petiolatis lanceolato-linearibus acutatis integris glabriusculis, rameis angustioribus; anthodiis alaribus campanulatis; glandulis bilobis, appendiculis binis lanceolatis seu abbreviatis; stylis vix basi connatis ad medium bilobis; stigmatibus erectis subteretibus; capsula læviuscula, seminibus ovatis acutis angulato-tuberculatis. Near the Copper Mines, New Mexico; *Bigelow.* Eastern Sonora; *Wright* (No. 1831). Stems 6–15 inches high; leaves 10–15 lines long, 1–2 lines broad; seeds 0.8 line long, strongly tuberculate and almost angular. Glands remarkable and very constant in shape; appendages white. Near *E. hexagona;* distinguished by the acuter more uniform leaves, bilobed glands, terete stigmata, and smaller tuberculate seeds.

EUPHORBIA BIFURCATA, *n. sp.*: glabra; caule erecto dichotomo; foliis oppositis ovatis seu obovatis in petiolem gracilem subæquilongum angustatis argute serratis obtusis basi glanduloso stipulatis; anthodiis alaribus breviter pedunculatis; lobis 5 ovatis truncatis fimbriato-multifidis; glandula singula cyathiformi late albo-appendiculata, appendice transverso emarginato; stylis basi coalitis ad medium bifidis, stigmatibus filiformibus. Moist places, Valley of the Limpio, July; *Bigelow.* Over a foot high; leaves 1 inch long, ½ inch wide; petiole a little shorter than leaf.

§ III. CYATHOPHORÆ.

EUPHORBIA DENTATA, *Michx.*; *β.* RIGIDA: humilior rigida; foliis parvis coriaceis reticulato-venosis scabris margine revolutis. Head of San Pedro River; *Wright* (No. 1837). Near Monterey, Mexico; *Dr. Edwards.* *γ.* CUPHOSPERMA: erecta, stricta, dentata seu parce pilosa; foliis lanceolatis seu lineari-lanceolatis elongatis subdentatis; capsulis glabris seu pilosis; seminibus majoribus tuberculato-angulatis. Copper Mines, New Mexico; *Wright* (No. 1834), to Sonora; *Schott.* Ojo de Gabilari, Chihuahua; *Thurber.*

EUPHORBIA HETEROPHYLLA, *Linn.* (*E. cyathophora*, Murr.) Var. GRAMINIFOLIA: foliis angusto-linearibus. Crevices of rocks and dry beds of rivers. Rio San Pedro, Texas; *Bigelow, Schott, Wright* (No. 653). South of El Paso; *Wright* (No. 1835).

EUPHORBIA BARBELLATA, *n. sp.*: annua, erecta, glabriuscula; foliis sparsis linearibus seu lanceolato-linearibus seu ovatis lobatisque breviter petiolatis parce argute dentatis, subtus ad nervum medium parce pilosis, basi pilis longioribus confertis barbatis; foliis floralibus ovatis seu e basi dilatata elongatis, basi roseis; anthodiis glomeratis majusculis; glandula singula sessili lobis inciso-dentatis breviore; stylis brevibus erectis basi vix connatis ad medium bifidis. On the Rio Grande, near Eagle Pass; *Wright.* Rio Frio; *Bigelow.* Near *E. heterophylla*, but stouter, leaves very sharply serrate, involucre larger, styles shorter. Leaves 2–4 inches long, ½ or ¾ inch down to 1 or 2 lines wide. Beard of coarse hair at base of leaves very conspicuous.

EUPHORBIA COLORATA, *n. sp.*: erecta, glaberrima; foliis breviter petiolatis sparsis patulis elongato- [191] linearibus revolutis integris; foliis floralibus basi paullo dilatatis puniceis subinde circinatis; glandulis 1–2 stipitatis cyathiformibus compressis margine revoluto sæpe crenulatis involucri lobos laciniatos coloratos superantibus; stylis brevibus purpureis erectis longe connatis, apice bifidis, stigmatibus acutis demum recurvis. Dry arroyos, Aqua Zarco, Sonora, May; and Santa Cruz, Sept.; *Thurber & Capt. E. K. Smith.* Specimens incomplete, nearly a foot high. Leaves 3–4 inches long, scarcely more than a line wide; floral leaves shorter and about 2 lines wide, deep crimson. Distinguished from *E. heterophylla* by the narrow revolute leaves, etc. Margin of involucre and styles also purplish. Capsule glabrous and seeds tuberculate, as in the allied species.

EUPHORBIA RADIANS, *Benth. Pl. Hartweg, p.* 38. Plains between San Bernardino and Santa Cruz, Sonora, April; *Capt. E. K. Smith.* Dry valleys near Buena Vista, Mexico; *Dr. Gregg, Dr. Wislizenus.* Mexico; *Berlandier* (No. 116 and 1375). Root tuberous; flowers in early spring, before the leafy shoots put out.

EUPHORBIA ERIANTHA, *Benth. Bot. Sulph. p.* 51. Sonora; *Wright* (No. 1841 ?).

§ IV. UMBELLATÆ.

EUPHORBIA WRIGHTII, *Torr. & Gray, Bot. Pope's Rep.* On the San Felipe and the San Pedro, Western Texas; *Wright* (No. 1827).

EUPHORBIA MULTICAULIS, *n. sp.*: annua seu biennis, multicaulis, humilis, erecta, glabra; foliis lineari-oblanceolatis acutis mucronatis serrulatis basi angustata sessilibus; umbellis trifidis, ramis bifidis, bracteis lanceolatis, superioribus ovato-lanceolatis acutis; involucri glandulis transverse ovatis; stylis basi liberis ad medium seu ultra bifidis; capsulæ coccis dorso verrucosis; seminibus lenticularibus lævibus fuscis. Sonora; *Thurber.* About a dozen stems from a tapering root, 6 inches high, and with erect branches; leaves 4–6 lines long, 1 line wide. Nearly allied to *E. obtusata.*

EUPHORBIA DICTYOSPERMA, *Fisch. & Mey. Ind. Sem. Petrop.* 1835. *E. Arkansana*, Engelm. & Gray, Pl. Lindh. 1, p. 26. Western Texas; *Wright.* Var. MEXICANA: annua seu plerumque biennis, e basi erecto-ramoso; foliis versus apicem crenato-serratis, lobis involucri subintegris; ovarii coccis dorso solum verrucosis. Valley of the Nagas, Balson de Mapimi, *Dr. Gregg;* Western Texas; *Wright* (No. 1824). γ. LEIOCOCCA: capsulis lævibus seu vix hinc inde verruculosis. Texas; *Drummond;* II. 327. Near the Colorado, of Texas; *Wright.*

EUPHORBIA TETRAPORA, *n. sp.*: annua, erecta, glaberrima; foliis cuneatis obtusis seu plerumque retusis emarginatis obcordatisve; umbellis trifidis; bracteis spathulatis seu superioribus orbiculatis basi truncatis; cornubus involucri setaceis glandulam transversam æquantibus; capsula dorso lævi; seminibus facie ventrali 4-punctatis, dorsali lævisculis. Georgia; *Boykin.* Louisiana; *Hale.* Texas; *Lindheimer, Wright.* Near *E. Peplus*, as is the following species, but distinguished by the capsule and the seeds.

EUPHORBIA PEPLIDION, *n. sp.*: annua, erecta, glaberrima, e basi ramosissima; foliis confertis e basi angustata lineari-oblanceolatis obtusis; umbellis 3-fidis dichotomis, bracteis lanceolatis acutis; cornubus involucri glandulam ipsam æquantibus linearibus obtusis; capsulæ coccis obtusis non alatis seminibus facie ventrali 2-sulcatis, dorsali punctato-exsculptis. Sandy soils, Western Texas; *Wright* (No. 1823). A small plant, 3–4 inches high, much branched from the base, of the habit of *E. exigua.* Seeds very similar to those of *E. Peplus*, 0.6 line long.

EUPHORBIA PEPLOIDES, *Nutt. in Trans. Amer. Phil. Soc.* (*n. ser.*) 5, *p.* 172, non *Gouan. E. longicruris*, Scheele in Linnæa, 22, *p.* 152. Western Texas; *Wright* (No. 1822); *Lindheimer* (No. 529 and 698); *Drummond* (coll. II. No. 331). If *E. peploides*, Gouan, of Southern Europe should prove to be a distinct species, Scheele's name must stand for ours. [192]

EUPHORBIA BRACHYCERA, *n. sp.*: annua (?), multicaulis, ramosa, erecta, glaberrima; foliis in petiolum brevissimum angustatis lanceolatis seu lineari-lanceolatis acutis mucronatis; umbella 3-fida seu raro 4–5-fida; ramis pluries bifidis; bracteis inferioribus ovato-lanceolatis superioribus rhombeo-orbiculatis mucronatis; glandulis brevissime obtuseque cornutis; seminibus majusculis ovatis maculis irregularibus sæpe confluentibus leviter impressis. Western New Mexico; *Wright* (No. 1821). Many stems a foot high from a stout but apparently annual or biennial root; leaves 6–9 lines long, about 2 lines wide, patulous (not erect as in *E. esulæformis*) regularly lanceolate; upper part of the stem quite ramose; horns shorter than in any of our species, and sometimes almost rudimentary. Seed 1 line in length, similar to those of *E. esulæformis, montana* and *Rœmeriana.*

EUPHORBIA MONTANA, *n. sp.*: perennis, glaberrima; caulibus pluribus ascendentibus; foliis brevibus lanceolatis ovatis obovatis seu suborbiculatis acutis seu obtusis basi subinde subcordatis subsessilibus coriaceis glaucis; bracteis omnibus orbiculato-triangularibus, rarius subcordatis, superioribus subinde transverse ovato-triangularibus, omnibus cuspidatis; glandulis semilunatis, cornubus triangulatis brevibus; seminibus maculis plus minus impressis obscuris confluentibus undique notatis.

α. GRACILIOR: caule tenuiori; foliis minoribus suborbiculatis obovatis seu lanceolatis.

β ROBUSTA: caule robustiore; foliis bracteisque majoribus crassioribus late ovatis seu ovato-cordatis.

The var. α. in New Mexico; *Fendler* (No. 786); *Wright* (No. 661, 1825). San Luis Mountains, Sonora; *Capt. E. K. Smith.* Stems 4–8 inches high, leaves 2–3 lines long, in young specimens imbricate and red.

Var. β. on the upper Platte (*James, Nuttall, Fremont*) is a much stouter plant. Leaves 5–6 lines long, seeds larger. Dr. Wislizenus collected intermediate specimens near Albuquerque.

EUPHORBIA CRENULATA, *n. sp.*: annua, erecta, glaberrima; foliis obovatis acutis in basin attenuatis minute crenulato-serrulatis mucronatis; umbella 5-fida, bracteis inferioribus late ovatis acutis, superioribus transversis, omnibus tenuiter serrulatis mucronatis; involucri glandulis longe tenuiterque cornutis; seminibus ovato-subglobosis cinereo-fuscis, maculis obscurioribus irregulariter confluentibus parum impressis. California; *Hartweg* (1950). Near Monterey; *Dr. Parry.* About 1–2 feet high, simple or branching above; leaves about 9 lines long, 5 lines broad, involucels broader and shorter; seed nearly a line long, unusually dark for this section. One of the very few peploid *Euphorbiæ* with crenate leaves.

EUPHORBIA ESULÆFORMIS, *S. Schauer in Linnæa*, 20, *p.* 729. Near the Copper Mines, New Mexico; *Wright* (No. 1820); *Bigelow.* On the Nueces, Western Texas; *Wright.* San Luis Mountains, Sonora; *Capt. E. K. Smith.* This species seems to be scarcely distinguishable from the Mexican *E. campestris*, Schlechtendal. The original specimen of the latter, however, has longer and more slender horns; the seeds are wanting. The original specimen of *E. esulæformis* has similar but smaller seeds than our plant; the horns are also very short and incurved, the gland itself is truncate and notched. *Euphorbia brachycera* and *E. montana* come very near to this species.

VAR.? SUBDENTATA: foliis oblongo-linearibus brevissime petiolatis, inferioribus integris obtusis, superioribus versus apicem mucronatum dentatis, bracteis ovatis obtusis sæpe grosse dentatis. San Francisco Spring, [193] Sonora; *Parry.* The seeds were not ripe. This is, perhaps, a distinct species, but it must remain as a variety until more complete specimens are obtained.

EUPHORBIA LATHYRIS, *Linn.*, is somewhat naturalized around Monterey, California. It was doubtless introduced by the Spaniards. We have it also from Saltillo, Mexico, where it was collected by Gregg.

§ V. SPARSIFLORÆ.

EUPHORBIA MISERA, *Benth. Bot. Sulph. p.* 51. Near the sea, San Diego, California; *Parry.* A straggling bush, about 3 feet high, abounding in a milky juice. Nuttall found it at Santa Barbara.

EUPHORBIA ANTISYPHILITICA, *Zucc. Acad. Mon.* 1, *p.* 292. Rocky and gravelly hills along the Rio Grande, from the Presidio del Norte to Laredo; *Bigelow, Schott.* Remarkable for its long terete nearly leafless branches, which resemble an *Equisetum* or an *Ephedra.*

CROTON FRUTICULOSUM, *Engelm. mss.:* caule basi fruticoso; foliis ovatis vel lanceolato-ovatis acumi- [194] natis acutisve subcordatis remote minutissime denticulatis eglandulosis supra viridis puberulis subtus dense stellato-pubescentibus; floribus monoicis pedicellatis, masculis racemosis 10–5-andris 5-petalis, fœmineis apetalis; stylis profunde bipartitis, laciniis elongatis filiformibus. Mountain sides and rocky ravines, Western [195] Texas; Chihuahua and Sonora. (No. 639 and 1803, *Wright*); the latter a dicœcious form. No. 176, 177, and 297 coll. 1846; No. 134 and 297 coll. 1847, *Lindheimer.* No. 3212, *Berlandier*, in part; the specimens with hairy fruit being *C. trichocarpa*, Torr. Leaves 1 to 2½ inches long, and half an inch to an inch wide, pubescence of the under surface often of a yellowish tinge. Inflorescence terminal and axillary in the upper leaves. Staminate flowers 10–20 or more. Petals 5, oblong. Stamens exserted; filaments smooth. Disk 5-lobed, glandular. Fertile flowers usually 2, sessile, apetalous; disk indistinct. Capsule globose-trigastric, covered with a short canescent stellate pubescence.*

* Supplementary Notes on Euphorbiaceæ of the Boundary appear in another paper, p. 440, note. — EDS.

II. EUPHORBIÆ OF A COLLECTION BY L. J. XANTUS IN LOWER CALIFORNIA.

FROM THE PROCEEDINGS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES, VOL. V. 1861; IN AN ARTICLE BY ASA GRAY.*

107. EUPHORBIA LEUCOPHYLLA, *Benth. Bot. Voy. Sulph. p.* 50. These specimens, from the original [168, 169] locality of the species, perfectly agree with Bentham's description, but would be called rather grayish-hoary than snow white; the leaves are very deeply and almost pectinately dentate, supported by extremely short petioles; the appendages of the dark red or almost black glands are very unequal, as they commonly are in *Anisophyllum*, and in no species more so than in *E. adenoptera*, Bertol. (*E. dioica*, HBK.), the posterior ones being always the largest; in the specimens before me the posterior appendages are one line broad and half as long, the anterior ones scarcely more than half a line broad and somewhat shorter; they are always crenate or even deeply incised, [170] the posterior more so than the anterior ones. Ovary and capsule together with the styles hairy, but the stipe glabrous: styles longer than ovary, distinct, about two thirds divided: stigmas scarcely clavellate. Seed oval, sharp-angled, slightly undulate, nearly 0.5 line long.

108. EUPHORBIA SETILOBA, *Engelm. in Bot. Williamson, Pacific R. R. Rep.* 5, *p.* 364. Identical with the plant from the Lower Colorado, described in the report above cited. Root thick, but evidently annual; many stems from a few inches to a span long, almost verticillate from the very base, an arrangement which is very striking in the Californian *E. polycarpa* and the European *E. Chamæsyce*, but not so distinct in most other *Anisophylla*. Lower leaves coarsely serrate; upper ones entire; in the Colorado plant all nearly entire. Involucra minute, scarcely a third of a line long; the glands perpendicular, not horizontal, dark red, with conspicuous white laciniate appendages. Male flowers, 5–8; in the original specimens scarcely ever more than 3. Ovary and capsule covered with short pubescence (not hispid); styles nearly $\frac{1}{4}$ line long, very slender, their branches remarkably club-shaped; seeds scarcely 0.4 lines long, sharp-angled, acute, transversely rugose. — Distinguished from the closely allied *E. polycarpa* by the slit in the posterior part of the involucrum, the shape of the appendages, and the more acute and much more rugose seeds. — *E. setiloba* has also been collected by Dr. Newberry in the sandy deserts west of the lower Colorado river.

109. EUPHORBIA POLYCARPA, *Benth. Bot. Voy. Sulph. p.* 50. No doubt identical with the original form, collected in the same neighborhood, but with rather larger leaves than Bentham describes. The specimens referred here by me in Bot. Mex. Bound. p. 186, undoubtedly belong here, as also *E. ocellata*, Nutt. in Hb. Hook., from San Diego, Coulter's No. 1448 in Herb. A. Gray, and specimens collected by Dr. Newberry near Los Angeles and in the Mohave desert. M. Boissier, however, distinguished, and perhaps justly, Wright's No. 1854, from the San [171] Pedro River in Arizona, under the name of *E. micromera*, in DC. Prod. ined., by the very small involucres (0.2 line long), the entire absence of appendages on the small yellow, not purple, glands, and the extremely short styles with subglobose stigmas. The length of the styles in these *Euphorbiæ*, however, is not a very safe character, as this specimen from San Lucas, and some others from Arizona and the Colorado desert prove: they have suberect styles shorter than the ovary (only about $\frac{1}{6}$ line long), while most forms from the State of California have elongated styles with divaricate clavate branches, twice as long as the ovary. My remarks about the variability of the plant may be extended to the shape of the leaves, which are usually oval, oblong, or oblong-linear, and obtuse at the base, but in specimens collected by Dr. Newberry at Laguna I find them almost orbicular and deeply cordate at the base. The stipules are divided on the upper, and united on the lower side of the stem, lanceolate-subulate, mostly entire and ciliate, in the specimen from San Lucas, however, glabrous. Stem and leaves usually glabrous, sometimes with a few scattered hairs, or entirely pubescent. The pubescent forms have always very narrow appendages, and the pubescence extends even to the ovary and capsule. The seeds are 0.4 line long, sharp-angled, with the sides almost smooth, or usually more or less distinctly undulate.

110. EUPHORBIA HYPERICIFOLIA, *Linn.* var. COMMUNIS, *Engelm. in Bot. Mex. Bound. p.* 188. *E. Preslii*, Gussone, Fl. Sicul. 1, p. 531; Boiss. in DC. Prod. ined. — Boissier's weighty authority has not convinced me that the Linnæan *E. hypericifolia*, with smaller flower heads, smaller capsules, and smaller and paler seeds, is distinct from our common northern var. *communis*. This latter has become naturalized in Italy, where it has been described under different names (*E. androsæmifolia*, Presl, *E. trinervis*, Bertol., and *E. Preslii*, Guss.); nor can I distinguish *E. lasiocarpa*, Klotzsch, from the West Indies and South America, by any character besides the pubescent capsules. Intermediate forms unite all these forms.

111. EUPHORBIA GYMNOCLADA *n. sp.*: fruticosa? ramis basi lignescentibus teretibus gracilibus strictis glabratis; foliis rameis ternatis internodio elongato multoties brevioribus linearibus seu oblanceolato-linearibus integris carnosulis (siccitate conduplicatis) subtus puberulis supra subnudis in petiolum brevissimum attenuatis; cymæ ter-

* The specimens were all collected in the vicinity of Cape San Lucas. — EDS.

minalis umbelliformis puberulæ radiis ternis iteratim dichotomis ; pedicellis bracteas anguste lineares et involucra magna æquantibus ; involucri hemisphærici extus intusque minute puberuli dentibus orbiculato-ovatis fimbriatis dentatisve, glandulis 5 transversis bilabiato-cyathiformibus appendice iis duplo latiore (alba seu rosea) orbiculata integra suffultis ; bracteolis paucissimis linearibus fimbriatis ; florum masculorum numerosissimorum stipitibus demum exsertis ; flore fœmineo breviter stipitato erecto glaberrimo ; stylis distinctis $\frac{2}{5}$ bifidis ovario æquilongis ; ramis clavatis divaricatis ; capsulæ coccis globosis ; seminibus ovatis obscuris depresso-tuberculatis ecaruneulatis. — Base of stem unknown, probably fruticose ; the slender branches below ligneous ; internodes 2–3 inches long. Leaves very deciduous, on the branches in threes, 4–7 lines long [the larger almost an inch long], and 1–1½ lines wide, on a petiole less than a line long. Cyme 1–1½ inches in diameter. Involucres with the large appendages 4 or 5 lines wide. Bracteoles very few (probably 5) outside of the 20 or 30 male flowers. Styles scarcely half a line long. Capsule 2½ lines in diameter ; cocci with a slight groove on the back : seeds about 1½ lines long, blackish-brown, covered with flattened tubercles. — Distinguished from the closely allied Mexican *E. peganoides*, Boiss. Cent. Euph. p. 21, by the small size of the bracts, the pubescence of the involucre, the shape of the glands, the large and entire appendages, and the short stipe of the ovary. The seeds of *E. peganoides* are unknown.[1] [172]

III. EUPHORBIACEÆ OF THE IVES EXPLORATION.

FROM REPORT UPON THE COLORADO RIVER OF THE WEST. WASHINGTON, 1861, PART 4, BOTANY.

APHORA SERRATA, *Torr. Bot. Mex. Bound. Surv., p.* 197. Gravelly places on the Upper Colorado ; January 25 to April 1. Flowers greenish white. [26]

CROTON (HENDECANDRA) PROCUMBENS, *Eschsch. ; Torr. l. c. p.* 195. On the bottom lands of the San Diego River, California ; November 9. Grows in tufts two and three feet high.

EUPHORBIA INÆQUILATERA, *Sonder in Linnæa ; Engelm. in Mex. B. Rep., vol. II., ined.* Mojave Valley. This is the same as Plant. Fendl., No. 803 ; an almost prostrate form, with small narrow leaves, which are only towards the end very slightly denticulate ; seeds scarcely undulate or nibbed. This species has a very wide extension ; it is found in Florida and the West India Islands, in the west from Nebraska to Texas and to California and Oregon (in India, *E. Nilayirica ;* in South Africa, *E. inæquilatera* and *E. setigera*), and in New Holland.

EUPHORBIA MELANADENIA, *Torr. in Bot. Whipple, P. R. Rep. IV., p.* 135. *E. cinerascens*, B., Engelm. in Mex. B. Rep. II., ined. In sandy arroyos, Camp 15, forming mats ; January 15, in flower, but without fruit. Many prostrate stems, a foot and more in height, from a ligneous root. The specimens before me are distinguished from those

[1] Notes to the *Euphorbiæ* of the Botany of the Mexican Boundary Survey, by the author, Dr. Engelmann.

Page 185. *E. petaloidea*, γ. *Nuttallii* is distinguished by M. Boissier (Cent. Euph. p. 10) under the name of *E. zygophylloides*, no doubt correctly. Another of M. Boissier's new species, *E. polyclada*, from Texas, sent by Wright and Lindheimer, seems to be only a smaller flowered form of *E. petaloidea* with narrower appendages and smaller seeds.

P. 186. *E. cinerascens*, β. *appendiculata* must give way to the earlier name of *E. melanadenia*, Torrey in Bot. Whipp. p. 135. — *E. cinerascens* will have to be named *E. melanadenia*, β. *subinappendiculata*.

P. 187. *E. inæquilatera*, Sonder. A careful examination of the original specimen of *E. serpyllifolia*, Pers. Syn. 2, p. 14, preserved in Herb. DeCandolle (a fragment of which has been kindly communicated to me), proves that this is the type of the American forms, referred by me to *E. inæquilatera ;* they will therefore have to bear Persoon's name. M. Boissier, discriminating perhaps too nicely, considers the Asiatic and African forms as distinct, and comprises them under the name of *E. sanguinea*, Hochst., to which *E. inæquilatera* and many other synonymes are referred.

The following two new species, of the section *Tithymalus*, were collected by Dr. Newberry in the recent expedition under Lieutenant Ives : —

EUPHORBIA SCHIZOLOBA, *Engelm. in Lieut. Ives's Rep.:* perennis, erecta, glaberrima, glaucescens ; foliis breve ovatis integris breviter cuspidatis in petiolum brevem attenuatis ; umbellæ trifidæ bracteis inferioribus rhombeis, superioribus transversis cuspidatis ; involucri glandulis stipitatis crenatis incisisve nec cornutis, lobis glandulosis emarginatis ; stylis ovario longioribus basi connatis. — East of the Lower Colorado, lat. 35°, alt. 2000 feet. Dr. J. S. Newberry, in Lieutenant Ives's Exped., March 26, in flower. — Amply distinguished from *E. montana* and other allied species by the peculiar shape of the glands and lobes of the involucrum. Stems 8–12 inches high. Leaves 5–7 lines long and 3–4 lines wide. Fruit and seeds unknown. — [By an oversight this name was substituted for *E. incisa*, employed in Ives's Report, part 4, p. 27, and has priority of publication ; see Bot. Calif. II. 75. — EDS.] [173]

EUPHORBIA LURIDA, *Engelm. l. c :* perennis, multicaulis, glaberrima, junior tota lurida ; foliis oblanceolatis integris basi angustatis subsessilibus patulis ; umbellæ 5-fidæ bracteis cuspidatis, inferioribus obovatis, superioribus suborbiculatis ; involucri glandulis transversis crenatis, lobis ovatis membranaceis ; stylis ovario multo brevioribus vix basi connatis. — Base of the San Francisco Mountains, lat. 35°, alt. about 7000 feet ; in flower at the end of April. Dr. J. S. Newberry. — From the nearly allied *E. esulæformis* it is distinguished by the absence of horns on the glands, &c. Stems of the very young specimens six inches high. Leaves 5 to 8 lines long and 1½ to 2 lines wide. Fruit and seeds unknown.

obtained by Dr. Bigelow by having unequal glands to the involucrum, those behind being much longer than those in front ; and especially by their petaloid rose-colored appendages. The seeds are not opaque, as Prof. Torrey says, but reddish gray.

EUPHORBIA POLYCARPA, *Benth. Bot. Sulph., p.* 49; *Engelm. in Mex. B. Rep. II., ined.* This is one of the most variable species of North America, if I understand it correctly. A form with narrow hispid pubescent leaves and very small appendages was collected with the last, and in the Purple Hills, forming dense mats on the sand of dry arroyos. Another, and the most showy form — the same that was found by Mr. Schott and Dr. Parry at San Diego, and of which a specimen from the same locality is in Dr. Hooker's herbarium, labelled by Nuttall *E. ocellata*, — was collected at Laguna, and was seen from Los Angeles to the Colorado. This showy form has almost smooth uniform leaves, and very large white appendages to the dark glands.

EUPHORBIA SETILOBA, *Engelm. in P. R. Rep., vol.* 5, *p.* 364. Gravelly beds of arroyos at Purple Hills. Also in flower in January, and probably the whole year round. Nearly allied to the last, with the same rough pubescence, but readily distinguished, not only by the deep laciniate appendages, but also by the almost naked inside of the involucres. I find them in Dr. Newberry's specimens generally triandrous, as Prof. Torrey has already noticed in the original specimen sent from Fort Yuma by Major Thomas.

EUPHORBIA (TITHYMALUS?) LURIDA, *n. sp.:* e basi perennante multicaulis, glaberrima, junior tota rubra lurida ; foliis oblanceolatis acutis basi angustatis subsessilibus patulis ; umbellæ quinquifidæ bracteis, cuspidatis, inferioribus obovatis seu oblanceolatis, superioribus suborbiculatis ; involucri parvi intus pubescentis glandulis transversis crenatis lobis ovatis membranaceis pubescentibus ; stylis ovario lævim ulto brevioribus vix basi connatis bilobis. Camps 81–82, San Francisco Mountain ; commencing to bloom at the end of April. I introduce this plant as a new species with a good deal of hesitation, as the specimens are scarcely enough advanced ; but, though the fruit is as [27] yet unknown, the plant seems to be well distinguished from any of the known North American or Mexican species. From the very similar *E. esulæformis* and its allies it differs by the absence of horns on the glands, and by the very short styles.

Stems of the young specimens just coming into flower are six inches high, with the leaves brownish red ; upper side of leaves greenish red ; leaves 5–8 lines long, and $1\frac{1}{2}$–2 lines wide ; involucre 1 line long ; linear bracts of the male flowers numerous, hairy. So that it is more nearly allied with *Tithymalus* than with *Esula*.

EUPHORBIA (ESULA?) INCISA, *n. sp.* [*E. schizoloba*, Eng. Proc. Am. Acad. V. 173] : perennis, e basi ramosa erecta vel ascendens, glaberrima, glaucescens ; foliis brevibus ovatis brevissime cuspidatis in petiolum brevem attenuatis ; umbellæ trifidæ bracteis cuspidatis, inferioribus rhombeis, superioribus basi truncata transversis ; involucri majusculi intus subnudi glandulis stipitatis transversis truncatis crenatis seu irregulariter incisis nec cornutis ; lobis involucri apice truncatis glanduloso-incrassatis profunde emarginatis seu irregulariter bilobis ; stylis ovario lævi longe exserto longioribus basi connatis bilobis. Camp 62, Long Valley. Stems 8–12 inches high ; leaves 5–7 lines long and 3 or 4 lines wide ; involucrum about two lines long, and, with the conspicuous glands, more than that in diameter. Flower, at end of March ; very nearly allied to *Euphorbia montana*, Engelm. in Bot. Mex. B. Expedition, with similar habits, leaves, umbels, but amply distinguished from this and all other peploid Euphorbias by the large involucrum, the absence of horns, and the incised nearly naked lobes. In all the allied species the lobes are membranaceous, ovate, obtuse, and on the inside villous. The bracts at the base of the male flowers are almost wanting, and the few occasionally found are nearly naked, while in most species they are pubescent or villous. The styles, much longer than the ovary, are united at the lower third and bifid at the upper third. Stigmas clavate ; fruit and seed unknown. This species is too nearly allied to some of our peploid *Esulæ* to be separated from them, though the glands are hornless.

IV. ON THE GENUS EUPHORBIA IN DECANDOLLE'S PRODROMUS.

FROM THE AMERICAN JOURNAL OF SCIENCE, 2D SER., VOL. XXXIV. 1862.

AFTER an interval of five years a continuation of the Prodromus, constituting a part of the [288] 15th volume, has just made its appearance, containing a monograph of the suborder *Euphorbieæ* by E. Boissier. The celebrated author has in this work described and arranged with admirable care, conscientiousness, and lucidity the heretofore almost unapproachable mass of species of one of the most numerous genera of plants spread over the whole globe. He has, with great propriety, retained this eminently natural genus as Linnæus constituted it, retaining as subdivisions some of the numerous genera into which former authors from Haworth to Klotzsch and Garcke have sought to divide it.

M. Boissier describes 693 species, which for the greatest part he had seen and carefully analyzed himself, and adds 30 others as incompletely known, thus constituting the most numerous genus known, after *Panicum*, of which Steudel enumerates 864 species, and larger than *Senecio*, of which DeCandolle knew 601 species. These species are arranged into two great divisions, the *Appendiculatæ*, with *petaloid* appendages to the glands of the involucrum, and the *Exappendiculatæ*, without such appendages. The former, containing 253 species, are for the greater part found in America: the latter, with 440 species, principally inhabit the Old World. This division of the genus is probably the most natural that could be made, though the first five species of the division are called by M. Boissier himself *Gymnadeniæ*, thus referring them properly to the second division, and [289] though other closely allied forms, such as *E. corollata* and *E. Ipecacuanhæ*, had to be widely separated on account of the difference in this particular.

The *Appendiculatæ* are divided into 11 sections, the first and largest of which is *Anisophyllum* with 176 species, the best known representatives of which with us are *E. maculata* and *E. hypericifolia*, here called *E. Preslii*. We have in our flora 36 species of this section; one of these, *E. Preslii*, is spread over the whole of North America; 6 are found in the Mississippi valley or east of it; 3 common in the West Indies, extending into Florida (of these *E. hypericifolia*, L., proper, is not mentioned as a Florida plant by M. Boissier); 24 are peculiar to the western plains, Texas, New Mexico and Arizona, and 2 are exclusively Californian. Several of the 24 southwestern species extend farther south into Mexico, and 2 of them, *E. prostrata* and *E. serpens*, which latter extends up the Mississippi and its confluents, are wide-spread species found through the warmer parts of the whole globe.

M. Boissier has recognized several forms as distinct species in which I have only been able to see so many varieties of one polymorphous species. Thus the old *E. hypericifolia* comprises his small-flowered and fruited tropical *E. hypericifolia* proper, our larger-flowered, larger and darker-seeded *E. Preslii*, and several tropical and eastern forms, as the hairy-fruited *E. lasiocarpa*, the large-seeded *E. Brasiliensis*, and others. *E. zygophylloides* was very properly separated from *E. petaloidea*, but *E. polyclada* I suspect is only a form of the latter. *E. micromera*, which I had taken for a form of *E. polycarpa*, seems well distinguished. I may add here that the western *E. serpyllifolia*, formerly united by me to several forms of the Old World under the name of *E. inæquilatera* and *E. glyptosperma*, has lately been found by Mr. T. J. Hale in Wisconsin; as also *E. Geyeri*, first discovered in Illinois, which last seems to preserve its distinction from *E. petaloidea*.

The second section, *Zygophyllidium*, comprises 4 species, of which 3 belong to the southwest and one to Mexico.

The 25 species of the 3d section, *Cyttarospermum*, are all inhabitants of the warmer parts of America, 13 being Mexican, and only one of our species, *E. bifurcata*, perhaps an intermediate link between this and the former section, is doubtfully referred here.

Sections 4 and 5 contain few (only American) species, none of them belonging to our flora.

Section 6, *Petaloma*, consists of 3 species, two of which, *E. marginata* and *E. bicolor*, belong to the west and southwest, and the third is a closely allied Mexican form.

Sections 7 and 8 are small and almost entirely South American.

The 9th section, *Tithymalopsis*, on the contrary, is entirely North American, 7 species belonging to our flora and one to Mexico. *E. corollata*, including *E. paniculata*, is the wide-spread and well-known representative of this section. The heretofore imperfectly known Michauxian species, *E. pubentissima* and *E. mercurialina* have been restored by M. Boissier, after a careful examination of the original specimens in Richard's herbarium, now in the hands of Mr. Franqueville of Orleans. The former, however, may be a variety of *E. corollata*. M. Boissier has from the same source ascertained that *E. polygonifolia*, Michx., is a form of *E. Curtisii*, though another specimen, in the herbarium of the Jardin des Plantes in Paris, is a form of *E. Ipecacuanhæ*.

Trichosterigma, the 10th section, comprises 5 species, all of them Western Mexican, two of which reach into our boundaries. The two species of the 11th section belong to South America.

The second great division, *Exappendiculatæ*, is divided into 16 sections, 2 of which only are represented in the North American flora.

Sections 12 to 14 contain few species, none of them belonging to our flora.

Section 15, *Poinsettia*, with 11 species, is almost entirely North American, or properly [290] Mexican; 1 or 2 species extending farther south, and 6 reaching into our flora. The best known representative of this section, *E. heterophylla*, has been restored, recognizing *E. cyathophora* and *E. graminifolia* as varieties of the Linnæan species. The New Mexican *E. euphosperma*, which I had described as a form of *edentata*, is here described as a distinct species. *E. eriantha* ought to have been mentioned as also occurring in Arizona. It may be remarked that the name of Arizona does not occur in this or other botanical publications, as a district formerly of the Mexican State of Sonora; just as Louisiana even yet, after 50 years of separate existence, sometimes is used in botanical works for the Upper Missouri country.

Sections 16 to 25, with 115 species, almost all belong to the Old World; they include the *Euphorbiæ* with succulent stems, those with the forms of *Cacti*.

Section 26, *Tithymalus*, comprises the great mass of the *Euphorbiæ* of the Old World. Of the 302 species constituting it we furnish only 23, most of which belong to the southwest; 5 others have been sparingly introduced from Europe into the Eastern States. The sub-section *Ipecacuanhæ* is the only sub-section of *Tithymalus*, whose species, 19 in number, all belong to the New World: 4 of them are peculiar to the Southeast; one comes over from the West Indies to the southern extremity of Florida, and allied as it appears to the Chilian forms, is peculiar to southeastern New Mexico. Of the sub-section *Galarrhœi* (with obtuse glands), out of 108 species we have only 5 native species, distributed from the Alleghany Mountains to Western Texas and California. The largest sub-section, *Esulæ* (with two-horned glands), comprising 139 species, counts in our flora 12 species, 2 of them in the Middle and Southern States, and all the rest belonging to Texas, New Mexico, and California.

The 27th section is constituted by a single species, an Australian shrub.

We find the name of two of our published species, viz., *E. commutata*, Engelm. in Gray's Manual, and *E. Floridana*, Chapm., in his Southern Flora, replaced by *E. Ohiotica*, Steud. & Hochst. and *E. sphærosperma*, Shuttlew., names which have been published only on labels in distributed collections, while *E. Rügeliana*, Shuttlew., has not been substituted for *E. Curtisii* though published in the same manner.

The following table exhibits the geographical distribution of the 80 species of *Euphorbia*, credited by M. Boissier to the flora of the United States. The immense extent of this flora may be properly divided into five districts.

I. Flora of the Northern and Middle States, or the flora of Gray's Manual, which however should naturally include the wooded part of Missouri, and exclude Northern Illinois and Wisconsin or the northwestern Prairie region. I adopt, however, Prof. Gray's limits, adding Missouri. II. Flora of the Southeastern and Southern States, east of the Mississippi, or the limits of Chapman's Flora. III. Flora of the western Prairie Region from the British Possessions to the Rio Grande. IV. Flora of the Rocky Mountains, including the greater part of Washington and Oregon, the whole of Utah, Colorado, New Mexico, and Arizona. V. Flora of the Pacific slope of the continent.

Some species extend through most of these regions, while others are common to several of them, and others again are limited to a single one; some extend into the extreme limits of our flora from the southern countries adjacent. The species, therefore, may be divided according to their geographical extension into the following 12 classes:—

1. Species common to the greater part of our territory. I class here *Euphorbia Preslii, serpens,*

serpyllifolia, *maculata*, *corollata*, *dentata*, *heterophylla*, and *dictyosperma*, though some of them are common only to the eastern, others more to the southern or western regions, and some [291] extend only to the edges of some of the floral districts: 8 species. 2. Species peculiar to the flora of the Northern and Middle States. I refer here a single species *E. Geyeri*, somewhat artificially it must be confessed, because it more properly belongs to the northwestern Prairie region; but thus far it has been found nowhere but in Northern Illinois and in Wisconsin: 1 species. 3. Species common to Gray's and Chapman's district: 6 species. 4. Species peculiar to the southeastern flora: 8 species. 5. Species common to the southeastern and the western flora: 3 species. 6. West Indian species extending into Florida: 4 species. 7. Species peculiar to the western and southwestern Prairie flora: 19 species. 8. Species common to the last and the following region: 3 species. 9. Species peculiar to the Mountain region of the west and southwest; many of these, as well as of section 7, undoubtedly extend into Mexico: 20 species. 10. Mexican species extending into the last region: 3 species. 11. Species common to the western Mountain region and the flora of the Pacific slope: 2 species. 12. Species peculiar to the Pacific slope: 3 species.

GEOGRAPHICAL DISTRIBUTION OF EUPHORBIÆ WITHIN THE FLORA OF THE UNITED STATES.

	1. Anisophyllum.	2. Zygophyllidium.	3. Cyttarospermum.	6. Petaloma.	9. Tithymalopsis.	10. Trichosterigma.	15. Poinsettia.	26. Tithymalus. 4. Ipecacuanhæ.	26. Tithymalus. 9. Galarrhæi.	26. Tithymalus. 10. Esulæ.	Total.
1. Common to whole country	4	..	..	..	1	..	2	..	1	..	8
2. Peculiarly northern	1	..	..	..	..	..	..	..	..	..	1
3. Northeast and southwest	2	..	..	..	..	..	..	1	2	1	6
I. Northeastern flora	7	..	..	..	1	..	2	1	3	1	15
1. Common to whole country	4	..	..	..	1	..	2	..	1	..	8
3. Northeast and southeast	2	..	..	..	..	..	..	1	2	1	6
4. Peculiarly southeastern	..	..	..	..	5	..	..	3	..	..	8
5. Southeast and west	2	..	..	..	..	..	..	..	..	1	3
6. From West Indies	3	..	..	..	..	..	..	1	..	..	4
II. Southeastern flora	11	..	..	..	6	..	2	5	3	2	29
1. Common to whole country	4	..	..	..	1	..	2	..	1	..	8
5. Southeast and west	2	..	..	..	..	..	..	..	..	1	3
7. Peculiar to Prairie flora	8	1	1	2	1	..	1	..	2	3	19
8. Prairie and Mountain flora	3	..	..	..	..	..	..	..	..	..	3
III. Western Prairie flora	17	1	1	2	2	..	3	..	3	4	33
1. Common to whole country	2	..	..	..	..	..	2	..	1	..	5
8. Prairie and Mountain flora	3	..	..	..	..	..	..	..	..	..	3
9. Peculiar to Mountain flora	9	2	..	..	..	..	3	1	..	5	20
10. From Mexico	1	..	..	..	..	1	..	..	..	1	3
11. Mountain and Pacific flora	2	..	..	..	..	..	..	..	..	..	2
IV. Western Mountain flora	17	2	..	..	..	1	5	1	1	6	33
1. Common to whole country	2	..	..	..	..	..	1	..	1	..	4
11. Mountain and Pacific flora	2	..	..	..	..	..	..	..	..	..	2
12. Peculiar to Pacific flora	1	..	..	..	..	1	..	..	..	1	3
V. Pacific flora	5	..	..	..	..	1	1	..	1	1	9
Flora of the United States	36	3	1	2	7	2	6	6	5	12	
	51						29				80

The following manuscript or herbarium names of Engelmann are taken up by Boissier in De-Candolle's Prodromus, 1862, xv. ii. *E. ovalifolia* and *E. rhytisperma* were first published by Klotzsch (Pflanzenklasse Tricoccæ, 1859, pp. 26 and 34.). — Eds.

E. asperifolia = E. strigosa, no. 267.
E. astyla, no. 125.
E. atrorubens = E. Ipecacuanhæ, var. gracilis, no. 391.
E. Baueri, no. 70.
E. calliadena = E. hispida, no. 111.
E. consanguinea = E. serpyllifolia, var. consanguinea, no. 141.
E. disticha, no. 93.
E. Engelmanni, β. depressa, no. 138.
E. floribunda, no. 122.
E. fruticulosa, no. 115.
E. Greggii, no. 583.
E. grisea, no. 130.
E. hortensis = E. Engelmanni, no. 138.
E. hypericifolia, var. *micrantha* = E. hypericifolia, no. 51.
E. leptocera, β. crenulata, no. 564.
E. Lindheimeriana = E. longicruris, no. 562.
E. maculata, β. detonsa, no. 156.
E. melanadenia, β. subappendiculata, no. 89.
E. notata = E. serpyllifolia, var. consanguinea, no. 141.
E. ovalifolia, and β. schizosepala, no. 139.
E. pilosula, no. 123.
E. prostrata, β. vestita, no. 158.
E. rhytisperma, no. 142.
E. serpens, vars. radicans and Indica, no. 80.
E. subserrata = E. serpyllifolia, var. consanguinea, no. 141.
E. tomentella, no. 90.
E. umbellulata, no. 126 (pp. 40, 1263).
E. villifera, β. nuda, no. 147.
E. Xanti, no. 222.
E. zygophylloides, vars. cymulosa and flagelliformis, no. 77.

V. EUPHORBIACEÆ OF WHEELER'S EXPLORATION.

From Report upon United States Geographical Surveys . . . in charge of First Lieutenant George M. Wheeler, Vol. VI., Botany, by J. T. Rothrock, 1878.

Croton corymbulosus. — Many erect stems from a ligneous base, a span to a foot high, simple below, [242] branching upward; stipules subulate, deciduous; petioles about half as long as the oval or oblong, mostly acutish, leaves, which are ¾–1¼ inches long, the lowest ones broader and shorter and often acutish at base, all triplinerved at base, penninerved upward, whitish below, greenish-gray above; stellate hairs slightly united to scales above, almost free and loose below; inflorescence short, loose-flowered, corymb-like, 6–8 lines wide, mostly monœcious; pedicels 2–3 lines long, much longer than the flowers; male flowers with 5 spatulate or lanceolate bearded petals alternating with the 5 lobes of the disk; 6–13 stamens with bearded filaments; female flowers mostly apetalous; styles bifid to below the middle or usually to the base, and together with the ovary and the oblong (3 lines long), capsule stellate scaly; seeds linear-oblong, 2 lines long, delicately punctate-reticulate. — Camp Bowie, New Mexico, *Rothrock*, 1874 (506). Through Western Texas (*Wright*, 641, 1805) into Mexico (Saltillo and Buena Vista, *Gregg*, 71, 288). This species was first described by Torrey in Bot. Mex. Boundary, p. 194, under the name of *C. Lindheimerianus*, in which Müller, DC. Prod. 15, 2, 579, followed him. But Scheele's plant thus named and described in Linnæa, 25, 580, is an annual, mistaken by him for a shrub, which was collected by Lindheimer near New [243] Braunfels, Tex., in 1846, and distributed in his sets under No. 526, and lately rediscovered along a railroad in the Indian Territory by G. D. Butler. This plant was by Müller taken for Nuttall's *C. ellipticus*, from St. Louis, which is, however, identical with *C. monanthogynus*, Michx., and in Gray's Manual, ed. 5, 438, the same species was again described as *C. eutrigynus*.

Croton Texensis, *Müll. l. c.* 692. — An annual, erect, dicœcious plant of the southwestern plains, Texas and New Mexico, 1–3 feet high, canescent or greenish-gray (when it is *C. virens*, Müll. l. c. 690), with linear-oblong leaves 2½ inches long on petioles ¼–½ inch long, without any glands; stellate hair free, not scaly; flowers apetalous; stamens usually 10–13; filaments hairy; styles twice or thrice 2-cleft at base, and, like the capsules, stellate-canescent; seeds orbicular-ovate, somewhat compressed, with a small deciduous caruncle below the apex. — Santa Fé, N. Mex., *Rothrock*, 1874 (37), originally described by Nuttall as *C. muricatus*, a name already preoccupied. *Hendecandra Texensis*, Klotzsch, and *H. multiflora*, Torr., are other synonymes for this plant. Nuttall's name refers to the curious knobs or almost spines on the capsule, which are covered with prominent tufts of stellate hairs. The styles are twice or often three times cleft, so that there are 12 to 24 stigmas.

Acalypha Lindheimeri, *Müll. l. c.* 875. — Many weak, ascending, downy stems from a thick ligneous root, a span to a foot high, branching from the base; leaves lanceolate-ovate, acute at both ends, serrate upward, hairy, on

short petioles, lower ones broader and shorter; slender, dense-flowered, terminal spikes 2–3 inches long, staminate upward; shorter spikes from the uppermost leaf-axils; bracts oval, deeply dentate; styles divided into many very slender, long-protruding, red branches. — Ash Creek, Arizona, *Rothrock*, 1874 (299), and through New Mexico to Western Texas. — Very near the Mexican *A. phleoides*, Cav., with which Torrey, Bot. Mex. Bound. 199, was inclined to unite it. The slender spikes with the delicate bright red fringes give the plant a very elegant appearance.

JATROPHA MACRORHIZA, *Benth. Pl. Hartw.* 8; *Müll. l. c.* 1087, var. SEPTEMFIDA. — Stems a span to a foot high, glabrous, very leafy; leaves glabrous, with the nerves of the upper surface puberulent, cordate, with an [244] acute sinus, broader than long, divided about $\frac{3}{4}$ or more into 7 ovate or ovate-lanceolate, incisely dentate, aristate lobes; stipules (2–3 lines long) setaceously divided; petioles about $\frac{1}{2}$–$\frac{3}{4}$ the length of the leaf; cymes densely many-flowered, short-peduncled, somewhat puberulent, with subulate-setaceous, entire, or the lower ones setaceously ciliate, bracts; sterile flowers $\frac{1}{2}$ inch long, with lanceolate, aristate, usually entire calyx-lobes, half as long as the spatulate petals; 5 (or rarely 6) exterior and 3 longer interior stamens, all united to about half their length, bearing equal, linear-oblong anthers; calyx-lobes of fertile flowers broader, larger, spinulose-dentate; styles 3, each with 2 oblong stigmas; capsule obtusely triangular, oblong, $\frac{1}{2}$ inch or more long; seeds linear-oblong (4–5 inches long), with a large hoodlike, cut-fringed caruncle. — Sulphur Springs, Arizona, *Rothrock*, 1874 (546), and to Southern New Mexico, and Chihuahua, *Wislizenus*. Leaves in the smallest specimens (*Wislizenus*, Chihuahua) 2 inches long by $2\frac{1}{2}$ inches wide, in Rothrock's largest, 6 by 8 inches, always with 7 lobes and usually with 2 smaller additional ones at base. Evidently a form of the Mexican *J. macrorhiza*, and with the same curious caruncle of the seed, distinguished by the longer petioles, the much more deeply divided leaves, with more numerous and more deeply cut-toothed lobes, and an acute (not wide or truncate) sinus. Torrey's *J. multifida*, Bot. Mex. Bound. p. 198 (not Linn.), is evidently the same thing, as already suggested by the author himself, and probably nearer Bentham's type than our plant, as the leaves are said to be only 3–5-lobed.

EUPHORBIA (ANISOPHYLLUM) ALBOMARGINATA, *Torr. & Gray in Pacif. R. R. Report*, 2, 174; *Bot. Mex. Bound.* 186; *Boissier in DC. Prod.* 15, 2, 30 — A prostrate, much branched, glabrous, glaucous perennial, with orbiculate-cordate, entire, rather fleshy leaves (2–3 lines wide) and conspicuous, triangular, membranaceous, whitish stipules; involucres axillary, solitary, or sometimes crowded into foliaceous cymules, broadly campanulate with conspicuous, white, transverse, entire or undulate appendages of the glands; capsules triangular; seeds reddish-gray, linear or oblong, smooth or sometimes very slightly undulate. — Zuñi, *Rothrock* (173 *in part*), 1874, to Fort Tejon, California (274), 1875, and generally from Western Texas to Southern California and into adjoining Mexico. A very distinct species, easily recognized by its glaucous color and whitish stipules and white appendages. In Arizona [245] it is called "Rattlesnake Weed," as its acrid juice is considered an antidote against the venom of that reptile. In Mexico, to this, as well as to other allied species, known under the name of *Golondrina*, great medicinal virtues are ascribed.

EUPHORBIA (ANISOPHYLLUM) FLAGELLIFORMIS, *Engelm. in Hayden's Bull. Geol. and Geog. Surv. Terr.* 2, No. 3, 243. *E. petaloidea*, var. *flagelliformis*, Engelm. in Bot. Mex. Bound. 185. *E. zygophylloides*, var. *flagelliformis*, Engelm. in Boiss. l c. 29. — A glabrous annual, with prostrate or ascending branches a span to a foot long; linear or oblong-linear entire leaves, acutish at both ends, 4–6 lines long, 1 line wide; conspicuous triangular incised stipules and alternate loose-flowered leafy corymbs; involucres broadly campanulate, with 2–4 large, concave, narrow-margined or inappendiculate glands; broad triangular capsule; smooth gray seeds thick and short, triangular, acute. — Camp Goodwin, Gila Valley, Arizona, *Rothrock* (339), 1874. Apparently a common plant in the sandy valleys of the Rio Grande (*Wright, Brandegee*) and Gila, but very rarely collected. Dr. Rothrock's specimens have a ligneous, very stout, tapering root 3 lines in diameter, with many stems (1–$1\frac{1}{2}$ lines thick) from the neck, just as we sometimes see other annual *Anisophylla*, *E. hypericifolia* among them, so that they simulate and actually become perennials; real perennials, however, such as the next species, have cylindric or tuberous roots, usually with slender and even filiform bases to the stems, which are buried beneath the surface. The slender leaves and the short, leafy, alternate flowering branchlets, much shorter than the internodes of the elongated stems, characterize this species at once. Like the Californian *E. ocellata*, it is distinguished by large cup-shaped glands, usually less than four in number, and scarcely or not at all margined.

EUPHORBIA (ANISOPHYLLUM) FENDLERI, *Torr. & Gray, Pacif. R. R. Rep.* 2, 175; *Bot. Mex. Bound.* 186; *Boiss. l. c.* 38. *E. rupicola*, Scheele, not Boiss. — Glabrous; many suberect or ascending, short, rigid stems of a finger's length from a perennial root; thick leaves, obliquely triangular-ovate to lanceolate, 1–$2\frac{1}{2}$ lines long, entire, often reddish; stipules subulate or somewhat lanceolate; involucres in terminal and lateral leafy cymules; glands with narrow or with longer, sometimes triangular, entire or dentate or lobed, greenish or reddish appen- [246] dages, or without any; seeds quadrangular-oblong, undulate and scrobiculate. — Santa Fé, *Rothrock* (13), 1874; number 1003 is the same from Arizona. Not rare from Western Texas, through New Mexico and Southern Colorado

to Arizona. A diminutive, suberect bush of many stems and branches, very variable in the width of its leaves, but readily recognized by the characters enumerated.

EUPHORBIA (ANISOPHYLLUM) POLYCARPA, *Benth. Bot. Sulph.* 50; *Bot. Mex. Bound.* 186; *Boiss. l. c.* 44. — A perennial, often flowering in the first year as an annual, prostrate or erectish, glabrous, sometimes pubescent (or even tomentose in a variety), with orbicular-cordate or oblong entire leaves, always with linear, delicately ciliate stipules; involucres axillary, rarely crowded into few-flowered cymes; appendages of the dark red (or, when dry, black) glands large and conspicuous, or smaller; seeds gray-reddish, linear-oblong quadrangular, smooth or slightly undulate. The typical large-flowered, glabrous form is found principally along the Pacific coast from Cape St. Lucas to the southern part of the State of California; inland, and especially in the California Desert and up the Gila, where Dr. Rothrock collected it in 1874, a larger, wide-spreading, very much ramified form is found, with smaller, glabrous or pubescent, oblong or oblong-linear leaves ½–1½ lines long, with smaller involucres, very small, almost or entirely inappendiculate glands, and very short styles, but seeds of the same size and form as in the type. The stipules of all forms are alike, linear, entire, minutely ciliate. *E. micromera*, Boiss. l. c. 44, seems identical with this last form, and we will have to consider *E. melanadenia*, Torr. Pacif. R. R. Rep. 4, 135, as a tomentose variety, as suggested by S. Watson; an intermediate form is *E. cinerascens*, Engelm. Bot. Mex. Bound. 186.

EUPHORBIA (ANISOPHYLLUM) SERPYLLIFOLIA, *Pers. Ench.* 2, 14; *Boiss. l. c.* 43; *Gray, Man.* 432. *E. inæquilatera*, Engelm. Bot. Mex. Bound. 187; not Sonder. — Zuñi, *Rothrock*, 1874 (173). An extremely variable species, but readily recognized by its glabrous, obovate leaves, acute at the unequal base, broader and serrulate at the rounded tip; stipules setaceously divided; involucres in lateral leafy clusters; seeds gray, linear, acutely 4-angled, slightly wrinkled or pitted. The closely allied *E. glyptosperma*, Engelm., may always be distinguished by the [247] broad semicordate base of the leaves, the lower half of which is protracted and almost auriculate, and by the sharply cross-ribbed and at the angles notched seeds. The form collected at Zuñi is suberect, nearly a span high, with leaves more sharply serrate than usual, and more distinctly rugose.

EUPHORBIA (ANISOPHYLLUM) PEDICULIFERA, *Engelm. Bot. Mex. Bound.* 186; *Boiss. l. c.* 48. — Plant, pale dull green, covered with a short, scanty pubescence; many prostrate stems from a perennial root, a span to a foot long; leaves rather large (6 lines long or more), oblique, oblong, obtuse, entire; small stipules triangular-subulate; involucres in few-flowered, lateral leafy cymes; glands with broad, dentate appendages; capsules canescent; seeds oblong, angular, strongly marked with 4 deep transverse grooves, deeply notched on the edges. — Cienega, near Tucson, Ariz., *Rothrock*, 1874 (576). A native of our extreme Southwest, from Arizona to Southern California and into adjoining Mexico; well marked by its larger, dull grayish-green leaves, and especially by the (for the section) large, deeply grooved and notched seeds, which curiously simulate some insect.

EUPHORBIA (ANISOPHYLLUM) HYPERICIFOLIA, *Linn.*; *Bot. Mex. Bound.* 188; *Gray, Man.* 432. — Two forms were collected by Dr. Rothrock in 1874. The common form (672) from Camp Crittenden, Southern Arizona, is that of the States, called *E. Preslii*, Guss., Boiss. l. c. 22, glabrous, with rather small, blackish, much cross-wrinkled seeds. The other form (720), from Camp Lowell, Southern Arizona, has seeds larger than the last, in size between those of *E. Brasiliensis*, Lam., and the large-seeded *E. Bahiensis*, Boiss., and in form similar to them; all of these have thick, short, almost ovate-cubic, black seeds, with few prominent tubercles arranged in about 2 interrupted transverse ridges. Our plant is nearly glabrous; leaves very pale below, with long, sparse cilia on the upper edge near the base. — The different species allied to *E. hypericifolia* require further study, as it is a mooted question whether the pubescence of the plant and even that of the capsules, and the size, the color, and the markings of the seed, constitute here specific differences. If they do not, then we have here one of the most polymorphous species, spread over all the warmer countries of the globe, and most difficult to define by floral and carpological, [248] but easily recognized by the vegetative characters.

EUPHORBIA (POINSETTIA) CUPHOSPERMA, *Boiss. l. c.* 73. *E. dentata*, var. *cuphosperma*, Engelm. Bot. Mex. Bound. 190. — A slender, erect annual, 1–1½ feet high, simple or with few erect branches, nearly glabrous, with few bristly hairs; leaves lance-linear, 1–2 inches long, upper involucral ones longer and a little wider, but scarcely discolored at base, all entire or with a few teeth on the revolute, scabrous margins; the large involucres in loose clusters, deeply campanulate, with 1 or 2, rarely more, slender, almost tubular glands; seeds short and thick, triangular, truncate at base, cross-ridged and tuberculate, with a minute caruncle. — Cienega (Creek), Arizona, near Tucson, *Rothrock*, 1874 (577).

A rare plant, found only once before, by Wright, mistaken by me for a form of *E. dentata*, but well distinguished from that species (which extends far into Mexico) by its involucres and seeds. *E. dentata* has much smaller turbinate involucres, with broad glands, and smaller ovate or subglobose, minutely tuberculated seeds.

EUPHORBIA (TITHYMALUS) DICTYOSPERMA, *Fisch. & Mey.; Boiss. l. c.* 135; *Gray, Man.* 434. — Camp Grant, Arizona, *Rothrock* (370), 1874.

EUPHORBIA (TITHYMALUS) CAMPESTRIS, *Cham. & Schlecht. Linn.* 1830, 84; *Boiss. l. c.* 146. *E. esulæformis*, Schauer, Linn. 1847, 729; Bot. Mex. Bound. 192. — Several erect stems, 1–1½ feet high, from a stout perennial root;

glabrous leaves linear-lanceolate; lower branches sterile with narrower leaves, upper ones flower-bearing; terminal umbel 5-rayed; exterior floral leaves ovate-lanceolate, interior ones shorter, but all longer than wide; involucres turbinate-campanulate, on pedicels of nearly their own length; glands semilunate, with short horns; styles longer than the ovary, united at base, bifid upward; seeds ovate, gray, marked with irregular, shallow, dark impressions.

Willow Spring, Arizona, *Rothrock*, 1874 (213); and southward and southwestward throughout Mexico. — The narrow leaves, especially on the sterile branches, and the narrow floral leaves, distinguish this species from its allies in the Southwest, and approach it, in habit at least, to the European *E. Esula*.

VI. COLLECTED DESCRIPTIONS OF EUPHORBIACEÆ.

From Engelmann and Gray's Plantæ Lindheimerianæ, Part I. (Boston Journ. Nat. History, V. 1845).*

171 Pilinophytum Lindheimeri [24, 25]. 174 Euphorbia bicolor [25]. 178 Cnidoscolus stimulosus [26].

Euphorbia Geyeri, *Engelm. mss.*: depresse, humilis; foliis oblongis retusis integerrimis glaberrimis; sti- [52]
pulis setaceo-multifidis; involucri appendicibus petaloideis; seminibus minoribus quam in *E. polygonifolia*, cinereis. — Beardstown, Illinois, and Upper Missouri, *Geyer*. Near *E. polygonifolia*.

302 E. Arkansana [53]. 303 E. marginata, β. uloleuca [53]. 306 Aphora humilis [54]. 307 Tragia brevispica [54].

From Gray's Manual, Second Edition, 1856.

4. E. humistrata, *Engelm. mss.* Procumbent, puberulent or hairy; leaves elliptical with an oblique [386]
obtuse base, serrulate towards the apex, sparsely hairy underneath ($\frac{1}{2}$–$\frac{3}{4}$ inch long, sometimes with a brown spot above); peduncles rather shorter than the petioles, crowded in lateral clusters; involucre cleft on the back, its appendages orbicular or truncate and nearly entire; pod acutely angled, puberulent; seeds ovate, 4-angled ($\frac{2}{5}$ line long).— With the last. — Branches 6–20 inches long. Distinguished from the next by its broader leaves, slit involucre, and rounder, granulated (not transversely grooved) seeds.

18. E. commutata, *Engelm. mss.* Stems branched from a commonly decumbent base (6–12 inches [389]
high); leaves obovate, the upper all sessile, the upper floral roundish-dilated, broader than long; pod obtusely angled, crestless; seeds ovate, pitted all over; biennial, annual, or perennial? — Along water-courses, from Virginia toward the mountains to Ohio and westward. — Leaves often persistent over the winter on sterile shoots, turning red, like those of the European *E. amygdaloides*. Seeds 1 line long, larger than those of *E. Peplus;* with which this has been confounded; but the character of the pod and seeds readily distinguish it.

From Torrey's Descriptions of Plants collected . . . by W. P. Blake (Pacific R. R. Repts. Botany, Vol. V. Appendix, 1857).†

Euphorbia setiloba, *Engelm. mss.*: prostrata, pilis brevibus patulis saepe glanduliferis tota puberula; [364]
foliis minutis e basi vix obliqua subcordata ovatis obtusis; stipulis minutis deciduis; glomerulis lateralibus; involucris dorso profunde fissis, appendiculis in lacinias 3–4 subulatas divisis; stylis elongatis fere ad basin bifidis, stigmatibus clavellatis divaricatis; capsula hispidula; seminibus ovatis acutatis transverse rugulosis. Near Fort Yuma. Stem 3 inches long. Leaves 1 line long, reddish. Appendages of the glands white, very conspicuous, almost setaceous. There are only about three male flowers in each involucre.

From Chapman's Flora of the Southern United States.

Euphorbia Curtisii, *Engelm.* Smooth; stems filiform; branches mostly 3, erect, sparingly divided; [401]
leaves thin, linear or linear-oblong, obtuse, short-petioled, spreading or recurved; involucres minute, scattered, on long capillary pedicels; glands green, margined by the white crenate appendages; capsule erect, short-stalked, round-angled; seed globose, smooth. — Low pine barrens, Florida to North Carolina. Aug. — Plant 6 to 9 inches high, sometimes branching from the base. Leaves $\frac{1}{2}$–$1\frac{1}{2}$ inches long. — [*First edition*, 1860.]

E. deltoidea, *Engelm. ined.* Small, perennial; stems (2–4 inches long) diffuse, glabrous; leaves ($1\frac{1}{2}$ line long or less) petioled, obliquely deltoid, cordate, or reniform, sprinkled with short hairs, the margins narrowly revolute;

* Several joint species, the descriptions of which are by Gray, are indicated merely by name. — Eds.

† Torrey's Botany of Whipple's Expedition contains without description the manuscript name *E. leptocera*, Engelm. Report, etc. vol. iv. p. 135. — Eds.

stipules minute, entire; involucre single, terminal (always ?) turbinate, pedicelled, with downy lobes, and transversely oblong glands without appendages; styles very short; capsule (immature) acutely 3-angled, glabrous. — South Florida, *Curtiss.* — [*Second edition*, 1883.]

FROM PARRY'S BOTANICAL OBSERVATIONS IN SOUTHERN UTAH (AMERICAN NATURALIST, VOL. IX. 1875).

247. EUPHORBIA PARRYI, *n. sp.* Annual, erect, slender, pale-green, glabrous, with dichotomous spreading [350] branches; leaves linear, nearly equal at base, acutish or acute at both ends, with setaceously slit stipules; involucres campanulate, on moderately long peduncles in the forks of the branches, with unequal small truncate appendages; style short, somewhat erect; capsule sharp-angled, seeds ovate, minutely granulate. — St. George, in loose drifting sand. Plant about a span in height; leaves ½–1 inch long, ½ line wide, rolled inward when drying; involucres ¾–1 line long, and with the greenish-white appendages of the same width; stamens numerous, with conspicuous feathery bracts between them; styles about the length of the ovary; seeds ¾ line long, rather thick, obtusely angled, surface covered with minute granules, disposed in transverse lines. Habit very similar to *E. revoluta*, Engelm., but that has a dark purplish-green color, revolute not involute leaves, very much smaller, slender turbinate involucres on short peduncles, and smaller, sharp-angled, strongly cross-ribbed seeds. The characters of our species point [351] to an alliance with *E. zygophylloides*, Boiss.

TETRACOCCUS, is a manuscript name applied by Engelmann to a new Euphorbiaceous genus from California, shortly before his death, and published nearly simultaneously by Parry (West American Scientist, Feb. 5, 1885, pp. 13–14) and Watson (Proc. Amer. Academy of Arts and Sciences, vol. xx. pp. 372–373). — EDS.

Feb. 21, 188

XI.

PAPERS ON ISOËTES.*

I. THE SPECIES OF ISOETES IN PARRY'S BOTANICAL OBSERVATIONS IN WESTERN WYOMING.

From the American Naturalist, Vol. VIII. 1874.

307. Isoëtes Bolanderi, *Engelm.* — Trunk deeply 2-lobed ; leaves (5–20, 2–4½ inches long) 4-angled, [214 (24)] slender, tapering to a very fine point, bright green, soft ; epidermis cells elongated ; with stomata, but without peripherical bast-bundles ; sporocarp mostly oblong, covered about ⅓ or ¼ by the velum, unspotted ; macrospores (0.30–0.45 mm. wide) beset with minute points and wrinkles ; microspores (0.026–0.031 mm. long) more or less papillose or spinulose, deep brown. — In ponds and shallow lakes on the Sierra Nevada of California, at an altitude of 5,000–10,000 feet, "scattered or rarely in small patches" (Tuolumne, Mount Dana, Mono-trail, Cisco, Mary's Lake, *H. Bolander*, 1866 and 1870), and on the Rocky Mountains, "densely cæspitose" (Yellowstone Lake 7,400 feet alt. *C. C. Parry*, No. 307, 1873).

This species represents in the western mountain regions our eastern wide-spread *Isoëtes echinospora*, var. *Braunii*, and the very local *I. saccharata*. Both collectors found it growing in soft mud covering gravel, and always submerged, but the abundant stomata would seem to indicate that the plant, at times, vegetates out of water. Leaves very slender, ⅓–½ line in diameter in the lower third, very broad winged below and toward the base. The minute, mostly pointed warts on the macrospores are often confluent, and then represent short wormlike wrinkles ; in some specimens I find them almost obliterated. The specimens from Yellowstone Lake are characterized by rather smaller macrospores (0.28–

* Dr. Engelmann contributed to the American Journal of Science the following papers, which contain a few relatively unimportant notes by himself : "A monography of the North American species of the genus *Equisetum*," by Alexander Braun (vol. xlvi. 1843, pp. 81–91); "A brief notice of the *Charæ* of North America," by Alexander Braun (l. c. pp. 92–93); "On the North American species of *Isoëtes* and *Marsilea*," by Alexander Braun (2 ser. vol. iii. 1847, pp. 52–56); "Notes on some Ferns of the United States," by Prof. Kunze (2 ser. vol. vi. 1848, pp. 80–89).

In the paper on *Equisetum* the following names by Engelmann appear, — *E. laevigatum*, A. Braun, β. *scabrellum*, Engelm., and γ. *elatum*, Engelm. [87], *E. robustum*, A. Braun, β. *minus*, Engelm., and γ. *affine*, Engelm. [88].

The paper on *Isoëtes* and *Marsilea* contains *Isoëtes riparia*, Engelm. mss. [53], and the following note : —

"I find a fourth species in the collections made by [56] Mr. Lindheimer in Texas. He met with it in January, 1845, in swampy soil on the lower Guadaloupe River, near its mouth in the Matagorda Bay. It is widely distinct from the three others, in having long and branching stipes (10 to 14 lines long) bearing 3 to 5 capsules, three or four times as long as these, and at the base connected with the petiole ; capsule obliquely obovate, with a short rhaphe, lower tooth blunt, upper one very indistinct ; stomata not observed on the paleaceous capsule ; rhizoma nearly naked, only the ends of the branches paleaceous ; petioles 4 to 9 inches long, hairy ; leaflets triangular or fanshaped, entire, more or less covered by fine paleaceous hairs, 7 to 12 lines long. It is no improbable that this is the *Marsilea polycarpa*, Hook. and Grev., found throughout South America, and lately discovered by Dr. Schiede in Mexico ; but having seen no description of it, I am unable to give more than this suggestion, based merely on the name. If on further comparison the Texan species should prove to be distinct, the name of *M. macropoda* would appear to be most appropriate. Sterile specimens of a *Marsilea* occurring in Drummond's Texan collections, belong probably to the same species as Lindheimer's plant." — Eds.

0.38 mm. wide) and a little smaller (0.026–0.029 mm.) almost smooth microspores, and may be distinguished as var. *Parryi*.

The only other species of Isoëtes, thus far found in the western mountains and on the Pacific slope, are, —

Isoëtes pygmæa, *Engelm.* — Very submerged, few (5–10), short (½ to 1 inch), stout, rapidly tapering [215(25)] dark-green leaves, with very short, often even square epidermis cells, without stomata or bast-bundles ; circular sporocarp with a very narrow velum ; macrospores 0.36–0.50 mm. wide, marked with smaller and more regular, rarely confluent, rather sharp points ; microspores (0.024–0.027 mm. long) brown, very minutely papillose or almost smooth. — In large patches in mud, covering gravel, deeply submerged in running water, on the Mono-trail, eastern declivity of the Sierra Nevada, 7,000 feet alt., *H. Bolander*, 1866. Closely allied to the last species, distinguished by its stout, short leaves without stomata, and the markings of the larger macrospores, etc. ; in many respects near *I. lacustris*.

Isoëtes Nuttallii, *A. Braun in litt.*— Terrestrial, trunk scarcely lobed; leaves (20–60, 3–7 inches long) 3-angled, slender, firm, erect, light-green, with numerous stomata and 3 peripherical bast-bundles ; sporocarp mostly oblong, entirely covered by the velum ; macrospores (0.35–0.52 mm. wide) densely covered with minute but prominent, rounded warts ; microspores (0.025–0.028 mm. long) papillose, deep brown. — On damp flats or springy declivities in Oregon ; on the Columbia, *Th. Nuttall*, 1833 ; Camass Prairies of the Cœur d'Aleines, *Chs. Geyer*, 1843 ; Willamette Valley, *E. Hall*, No. 693, 1871. Thin but firm leaves, as most land Isoëtes have, with three strong bast-bundles corresponding to the 3 angles. Trunk rhombic in transverse section, only superficially divided by a shallow groove into two lobes. Closely allied to *I. melanopoda* of the Mississippi Valley, which Mr. Hall lately discovered also in Texas, but resembling in the velum the two Florida species *I. flaccida* and *I. Chapmani*.

Isoëtes echinospora, *Dur.*, var. Braunii, *Engelm.* — In the Uintah Mountains, at 9500 feet alt., *S. Watson*. The westernmost and the highest known locality of this species.

II. THE SPECIES OF ISOËTES OF THE INDIAN TERRITORY.

From the Botanical Gazette, Vol. III. 1878.

Isoëtes melanopoda, *J. Gay*, originally found in Central and Northern Illinois, then in the neighboring [1] regions of Iowa, seems to be peculiar to a belt of prairie country extending from northeast to southwest, from Illinois to Iowa, the Indian Territory and Texas. Mr. E. Hall, who discovered the species in Illinois, found it also some years ago in Dallas county, Texas, and now Mr. G. D. Butler sends it from the Indian Territory. However the other characters may vary, the macrospores everywhere readily characterize the plant. They are the smallest of any of our species, but varying in the same sporangium, between 0.25 and 0.35 mm., very rarely as much as 0.40 mm. in diameter, marked with confluent knobs and curved and twisted (worm-like), low, sometimes almost indistinct, elevations, visible, of course, only under a strong magnifier. The velum or membranaceous fold, which more or less completely covers the spore case, or is, rarely, wanting, is in this species usually narrow, or sometimes wider ; in the southern forms it covers about one-third of the upper half of the sporangium. Full-grown specimens are ½–1 inch in diameter at the almost always black and shining base of the leaves ; these, smaller and fewer in the northern forms, are in the southern ones 20–50 in number and 8–12 inches in length, and, as I have described them in Gray's Manual, triangular, with 4 peripherical fibrous bundles and with numerous stomata.

Isoëtes Butleri, *n. sp.*, I name an allied species discovered by Mr. Butler, near the latter, in drier soil, a much smaller plant with earlier (beginning of June) maturity. It is at once recognized by its larger macrospores, 0.50–0.63 mm. in diameter, marked with distinct knobs or warts, which rarely run together. The base of the plant is only ½ inch thick, the slender leaves with dull whitish bases, only 8–12 in number, are 3–6 or 7 inches long, of exactly the same structure as those of the last species. Velum very narrow or almost none. Microspores aculeolate in both, in the latter species a little larger than in the former.

The species of Isoëtes are usually, as is well known, monœcious, the exterior sporangia bearing female or macrospores, the interior, later developing ones, male or microspores. But *I. melanopoda* is oftener diœcious than monœcious. Mr. Butler examined hundreds of specimens and found about one-third monœcious and two-thirds diœcious, and of these the male and female plants in about equal numbers. Of *Isoëtes Butleri* he never could find a monœcious plant; all the specimens which he found as well as those which I examined, were diœcious, both sexes in about equal numbers.

III. THE GENUS ISOËTES IN NORTH AMERICA.*

From the Transactions of the St. Louis Academy of Science, Vol. IV. 1882.

§ 1. History of Isoëtes in North America.

The *Isoëtes*, insignificant and apparently sterile as they are, were long overlooked or [358 (1)] ignored by our botanists, so that until thirty or forty years ago very few specimens were collected, and none were distinguished from *I. lacustris*, if we except Nuttall's guess at his Oregon discovery; but the genus has attracted so much attention, and lately so many forms have become known, that it seems to me an interesting task to trace up the history of the discovery of the different species and their varieties, and of the area of their distribution, and then the date of their publication, before I enter into their scientific description.[1]

* The revision of Eastern Isoëtes by Dr. Engelmann, in Gray's Manual, 5th ed., 1868, 675–677, has been omitted from this volume. The original description of *I. saccharata*, which appeared in it, is given as a foot-note at the proper place. — Eds.

[1] 1. Discovery. — 1806 (?). The first notice which we have of an *Isoëtes* in North America is given in Pursh's Flora, ii. 671, where he states that "*Isoëtes lacustris*" grows in the bottom of Oswego River, near the falls, and adds his *v. v.*, which means that he saw it living, and therefore probably found it himself; and as he travelled through the regions near the Great Lakes in 1806, it was probably in that year that he met with it. I have not seen Pursh's specimens, but doubt not but that it will have to be referred to *I. echinospora*, var. *Braunii*, the only form thus far known from Western New York.

1815. Th. Nuttall collected "*I. lacustris*" abundant along the inundated gravelly and miry shores of the Delaware at Gibsonville (now a part of Philadelphia) on Aug. 22, according to the label of a specimen in Collins's Herbarium, presented to me by E. Durand. It proves to be *I. riparia*.

1820 (?). Louis von Schweinitz obtained in the Catskill Mountains in New York *I. lacustris*. Some of his specimens are now found in the Herb. Philad. Acad. Natural Science, and one in the St. Petersburg Imperial Herb. Some of them are labelled "Catskill Mountains," and others "Bethlehem," the latter, which was von Schweinitz's residence, probably by mistake. One of the specimens was loaned by the late Elias Durand — in whose possession it was — to Durieu de Maisonneuve, who founded on it his I. macro- [359 (2)] spora. No date being indicated on the labels, the above-mentioned year is a mere guess.

1825 (?). Jens Vahl collected in Greenland a small *Isoëtes*, referred to *I. lacustris*, which proves to be one of the forms of *I. echinospora*.

1831. J. W. Robbins gathered an *Isoëtes* near Uxbridge, Mass., which I recognize as *I. riparia*.

1832. C. J. Moser, who collected for the German *Unio Itineraria*, obtained specimens on the Lehigh River, near Bethlehem, Pa., and near Philadelphia, both of which were distributed to the subscribers as *I. lacustris*. One of these (in Herb. Bernhardi, now in the Herb. Missouri Bot. Garden) represents *I. Engelmanni*; another, which I have seen in Europe, is *I. riparia*.

1834. Th. Nuttall discovered an *Isoëtes* on the Columbia River in Oregon, which I saw in E. Durand's Herb. with Nuttall's own label, *I. opaca*; it was afterwards named I. Nuttallii. About the same year Drummond collected "*I. lacustris*" on the Saskatchewan, according to Hooker's Fl. Bor.-Am. ii. 268, which I have not been able to compare and to identify.

1840. J. W. Robbins found *I. lacustris* near Uxbridge.

1842. Rugel discovered an *Isoëtes* in Lake Imonia in Florida, which was soon afterwards distributed in Europe by Shuttleworth under the name of I. flaccida. None of his specimens are believed to exist in America. In the same year N. Riehl and myself found near St. Louis, Mo., the species which from my specimens was by A. Braun named I. Engelmanni.

1843. Chas. Geyer found in Western Idaho *I. Nuttallii*, according to A. Braun, who examined the specimens in the Kew Herbarium. In the same year E. Tuckerman collected *I. lacustris* in the Echo Lake in New Hampshire.

1844. Wm. Zantzinger rediscovered the *Isoëtes* on the banks of the Delaware, near Philadelphia. His specimens, sent to me, are the type of my I. riparia.

1845. T. W. Robbins found in Massachusetts *I. echinospora*, var. *Braunii*.

1848. E. Tuckerman discovered near Boston the species which was by A. Braun named for him, I. Tuckermani.

1850. A. W. Chapman found in Northern [360 (3)] Florida a peculiar *Isoëtes*, which proved to be a large-spored form of *I. flaccida*, and was named var. Chapmani.

1853. E. Hall discovered in his fields near Athens in Central Illinois the species which was afterwards named by J. Gay I. melanopoda.

1856. I found *I. echinospora*, var. *Braunii*, in Lake Winnipiseogee in New Hampshire, the type of I. Braunii, Durieu.

1857. D. C. Eaton obtained *I. Engelmanni* for the first time in the New England States.

1860. Wm. Boott found near Boston the form of *I. echinospora*, which was named from his specimens I. muricata by Prof. Durieu, the present *I. echinospora*, var. *muricata*.

1862. Th. C. Porter discovered near Lancaster, Pa., the largest American *Isoëtes*, *I. Engelmanni*, var. valida. In the same year G. Vasey found *I. melanopoda* in Iowa.

1863. J. Macoun obtained *I. echinospora*, var. *Braunii*,

§ 2. Morphology of Isoëtes.

The species of *Isoëtes* are the simplest vascular plants known. They consist of a short trunk[2] with root-fibres at its base and leaves on its top, normally without branching and without any axillary productions.[3]

in West Canada. In the same year Wm. M. Canby discovered in Maryland I. SACCHARATA.

1865. Leidy and Porter collected *I. lacustris* near the outlet of Lake Superior. In the same year *I. Tuckermani* was rediscovered near Boston by Wm. Boott.

1866. Charles Wright discovered I. CUBANA in Eastern Cuba. In the same year H. Bolander found two new species in the Sierra Nevada of California, I. BOLANDERI and I. PYGMÆA.

1867. Wm. Boott got near Boston the species named after him I. BOOTTII, now known as *I. echinospora*, var. *Boottii*.

1869. Wm. M. Canby discovered on the Stone Mountain in Georgia the curious little I. MELANOSPORA. In the same year S. Watson found *I. echinospora*, var. *Braunii*, in Utah.

1871. E. Hall gathered beautiful specimens of *I. Nuttallii* on the Columbia River, and in 1872 traced *I. melanopoda* to Texas.

1873. T. P. James got *I. echinospora*, var. *Braunii*, in Nova Scotia, and C. C. Parry found *I. Bolanderi* in Yellowstone Lake, in Wyoming.

1875. G. D. Butler discovered in the Indian [361 (4)] Territory the species named for him I. BUTLERI, and with it a new locality for *I. melanopoda*.

1878. C. G. Pringle found in Lake Champlain the form of *I. echinospora*, which I have designated as var. ROBUSTA.

1879. M. E. Jones met with *I. Bolanderi* in Utah.

1880. A. Gattinger discovered near Nashville, Tenn., *I. Butleri*, var. IMMACULATA.

1881. I collected *I. lacustris*, var. PAUPERCULA, in Grand Lake, Middle Park, Colorado; and C. G. Pringle found the same in Northern California.

2. PUBLICATION. — 1753. Linnæus published in his Species Plantarum, ed. i., his *Isoëtes lacustris*, the only species known to him.

Neither Michaux nor any of the older writers on American plants knew of any North American *Isoëtes*.

1816. Pursh, Fl. Am. Sept. ii. 671, mentions "*I. lacustris*," from Oswego River, Western New York, which is most probably *I. echinospora*, var. *Braunii*, the only species thus far known from that region.

1818. Nuttall, Gen. ii. 253, has "*I. lacustris*" from the miry shores of the Delaware, near Philadelphia, which cannot be any other than *I. riparia*; he also gives Pursh's habitat. In the same year Barton, Fl. Philad. ii. 213, has "*I. lacustris*" from Philadelphia, which may include both *I. riparia* and *I. Engelmanni*.

1824. Elliott knows no *Isoëtes*.

1826. Torrey, Comp. Fl. North. & Middle States, gives as habitat of "615, *I. lacustris*," bottoms of lakes, evidently without having himself seen it. In the Flora Cestrica of the same year Darlington does not mention the genus.

1827. Sprengel, Syst. Plant. iv. 9, knows only *I. lacustris* with three varieties.

1833. Beck, in his Botany, repeats Pursh's and Nuttall's localities.

1840. Hooker, Fl. Bor.-Am. ii. 268, mentions "*I. lacustris*" from the Saskatchewan. This may be the true *lacustris* or a form of *echinospora*, either of [362 (5)] which may be expected in those regions.

1843. Torrey, Flora of New York, ii. 514, "*I. lacustris*," a mere repetition of Pursh's statement.

1844. Bory investigates the genus, which until then had been very much neglected, and adds to the three then known species (*I. lacustris*, *Coromandelina*, and *setacea*) three new ones discovered in Algeria by Durieu de Maisonneuve.

1846. A. Braun, in Regensburg Bot. Zeitung, No. 12, briefly characterizes *I. riparia*, Engelm., from Philadelphia; *I. Engelmanni*, A. Br., from Missouri, and *I. flaccida*, Shuttlew., from Florida.

1847. The Amer. Journ. Arts & Sciences, n. ser. iii. 52, publishes a translation of the above notice.

1848. A. Gray, in the first edition of the Manual Bot. North. States, p. 640, distinguishes the then known three northern species, *I. lacustris*, *I. riparia*, and *I. Engelmanni*.

1853. Darlington, Fl. Cest. ed. ii. p. 402, mentions "*I. lacustris*" as growing in shallow ponds in his district. This must refer to *I. Engelmanni*, the only species growing there in such localities.

1856. A. Gray, Manual, ed. ii., gives an almost verbal reprint of the first edition.

1860. Chapman, Fl. South. States, p. 602, describes *I. flaccida* as growing in "lakes and clear streams" in Middle and West Florida. In the same year E. Tatnall, Cat. Pl. Newcastle Co., Delaware, enumerates *I. riparia* and *I. Engelmanni*, both of which names here probably stand for the latter.

1861. Durieu de Maisonneuve, Prof. of Botany at Bordeaux, in Bull. Soc. Bot. France, viii. p. 164, distinguishes and characterizes the two North European species *I. lacustris* and *I. echinospora*, heretofore thrown together.

1864. The same author, l. c. 101, 102, indicates four American *Isoëtes*: *muricata* from Massachusetts, *Braunii* from New Hampshire, *macrospora* from the Catskill Mountains, and *melanopoda*, Gay (or Gay and Durieu), from Illinois. In the same year A. Braun published a most important treatise on the genus in his account of the *Isoëtes* of the Island of Sardinia, in which our species are frequently referred to.

1867. In the fifth edition of Gray's Manual, [363 (6)] p. 676, I for the first time published *I. echinospora* as an American species, differing in several varieties from the European type — var. *Braunii* (*I. Braunii*, Dur.), var. *muricata* (*I. muricata*, Dur.), and var. *Boottii* (*I. Boottii*, A. Braun in litt.), all of them from the Northeastern States; also *I. Tuckermani*, A. Braun in litt., from Massachusetts, and *I. saccharata*, Engelm., from Maryland.

1874. In Dr. Parry's Botanical Observations in Western Wyoming, Am. Naturalist, viii. 214, 215, I gave an account of the three western species: *I. Bolanderi*, Engelm.; *I. pygmæa*, Engelm., and *I. Nuttallii*, A. Br. in litt.

1877. My notice of *I. melanospora*, Engelm., from Georgia was published in the Trans. Acad. Sci. St. Louis, iii. 395, note.

1878. In Coulter's Botan. Gazette for January, p. 1, I gave an account of *I. Butleri*, Engelm., found in the Indian Territory west of Arkansas.

[2] A very complete account of the structure of the trunk is given by H. Mohl in Linnæa, xiv. (1840) 181, and of the whole plant and its morphology by A. Braun in the *Isoëtes* der Inse Sardinien, Monatsber. d. Berliner Acad. Wissensch. 1864.

[3] Abnormally the *Isoëtes* trunk has been seen divided,

The TRUNK is generally depressed, broader than high, or flatter in some species (*I. Engelmanni*), and thicker and more globose in others (*I. melanopoda*), but its form is not constant; it is concave on the upper side and even somewhat funnel-shaped where the leaves are inserted, while the under side shows in almost all the N. American species two grooves and in many exotic ones three grooves, dividing the trunk more or less deeply into two or into three lobes. The number of lobes rarely varies, so that among the many hundreds and even thousands of American specimens which have passed through my hands, I have found only a single, normally bilobed, one with three lobes; this was an *I. riparia* from Philadelphia. In the 3-lobed species the transverse [364 (7)] section is rather circular, but in the 2-lobed ones it is usually oblong or often somewhat rectangular, narrower in the direction of the grooves and wider in the opposite direction; the vertical section of the trunk shows a thickness of from 1 to 6 lines, and the transverse diameter a width of a few lines to more than one inch. In the centre of the trunk we find a small ligneous body, fibres from which enter the leaves and the roots. The mass of the trunk is a white parenchymatous or rather cortical tissue, the cells of which are filled with starch. The growth proceeds from the central ligneous body outwardly in two or three directions, corresponding to the two or three lobes, so that these lobes would spread laterally if their enlargement were not limited by the decay of the older (the preceding year's ?) parts. We thus find that at the period of the most vigorous growth, about the beginning of fructification, the extreme lateral portion of the lobes becomes discolored, brownish, atrophied, and at last black, and is separated from the living tissues by a distinct line of demarcation, and at last generally falls off at the end of this or the beginning of the next season as a black mould-like mass. In some species, e. g. *I. lacustris*, and in colder climates the atrophied cortical parts continue to cohere for several seasons, and in the Mediterranean *I. Hystrix* they do not seem ever to be detached, so that the trunk of this species reaches a larger size than any other.

The decaying portions are pushed obliquely upwards when the base of the trunk grows faster than the upper part (often in *I. Engelmanni*, and much more so in the Australian *I. tripus*), or horizontally outward (the ordinary case), or downward when the upper or leaf-bearing part expands more than the lower, root-bearing part. This last is the case in *I. Hystrix*, where the dead parts are turned downwards.

As the growth of the trunk takes place from the centre outward, the roots, originating from the youngest parts, start from the groove itself; and fresh and living whitish ones are only found in or near this groove: as they get older they are pushed to the sides, and finally die, becoming brown and black. The mass of roots found on *Isoëtes* specimens are mostly the entangled dead fibres, which, by the way, often conceal spores of the previous year, and therefore must be carefully examined when no fresh spores are attainable. The root-fibres, sometimes longer than the [365 (8)] leaves, are always dichotomously, and often many times, branched. — The upper, concave surface of the trunk bears the leaves, the innermost or youngest ones often yet immersed in the trunk.

The LEAVES are subulate or sometimes almost filiform tubular organs from a broad membranaceous sheathing base, mostly more or less quadrangular (broader and with sharper edges on the upper or ventral, narrower on the dorsal side), or in our terrestrial species more triangular and keeled on the back. Their sheathing bases form the *bulb*, which can be compared to the bulb of liliaceous plants; in fertile specimens it is always larger and thicker than the trunk, and in some of the larger ones, e. g. *I. Engelmanni* and *I. melanopoda*, attains a diameter of one or two inches. The leaves above this base contain four longitudinal air cavities, *lacunæ*, separated from one another by two dissepiments, a transverse and a median one, and irregularly divided by very thin transverse *septa*. The dissepiments are of different, pretty constant thickness in the different species, thinnest

probably in consequence of some injury; I myself have seen a specimen of *I. Tuckermani* with four distinct bunches of leaves from a single trunk. K. Goebel found a proliferous *Isoëtes* with lateral shoots in place of spore-cases. Bot. Zeitung, 1879, No. 1.

in the amphibious and thickest in the terrestrial species, consisting in the former often of only 2–4, in the latter of 6–9 layers of parenchymatous cells; the median dissepiment is generally a little thicker than the transverse one. The anterior *lacunæ* are mostly somewhat larger than the posterior ones.

The epidermis of the leaf consists of rectangular cells, mostly much longer than they are wide; only in *I. pygmæa* are they comparatively short, and sometimes even square. In a few species the epidermis is entirely destitute of stomata, in the others it is pierced by stomata which communicate with the air-ducts, over which alone they are found. The presence or absence of stomata furnishes a very important character for the diagnosis and classification of the species. It was formerly thought that the submerged species had no stomata, and those species which bear their leaves more or less exposed to the air were provided with them; later discoveries, however, have shown that this rule does not always hold good, for we now know submerged species with stomata and emerged ones without them, and we have one submerged species (*I. echinospora*) in which the typical European form is destitute of stomata, while the American varieties show either a few [366 (9)] stomata, often difficult to discover, or, rarely, numerous ones; so that in this interesting species the question arises whether the presence or absence of stomata *alone* can specifically separate forms otherwise scarcely distinguishable, as that acute observer of these plants, A. Braun, has maintained, or whether the stomata do *not* always play that important part in classification generally assigned to them. Below will be found directions for the investigation of the stomata.

The parenchyma of the leaf consists of a few or several layers of chlorophyll-bearing cells, (1) under the epidermis, (2) around the central bundle of vessels, and (3) forming the dissepiments, which cross each other in the centre of the leaf.

An important element in the leaf structure is found in the peripheral bast-bundles, which are present in some and absent in other species; and their presence often, but not always, coincides with the presence of stomata. When present they commonly form four bundles, two in the two anterior angles of the leaf, and two where the median dissepiments connect with the anterior and the posterior wall of the leaf; in *I. Nuttallii* I find only three bundles, the anterior median one being wanting; in *I. Cubana* six bundles are visible, the two additional ones being located where the transverse dissepiment unites with the outer wall. In some rigid-leaved land species, e. g. *I. melanopoda*, often several smaller accessory bundles are found scattered under the epidermis.

The examination of the fresh *Isoëtes* leaf is not very difficult; particles of the epidermis are easily removed, and show the stomata, when present, very distinctly. Where there are few stomata, the epidermis from different parts of the leaf must be examined, and especially from the tip, as they are more apt to be found there. In dried specimens the leaf must be soaked, the *algæ* which often adhere to the surface have to be carefully scraped off, after which I make several sections $\frac{1}{4}$ or $\frac{1}{2}$ line wide, lay them open by a vertical slit, detach the central bundle, and then scrape very gently the inner surface so as to remove the parenchymatous cells which obscure the appearance of the stomata. This process can be aided by an immersion of the specimen in a weak solution of caustic potash. The work is often a difficult one when the specimen is very old or poorly preserved, and requires a good deal of patience. Sometimes the application of iodine will [367 (10)] very distinctly show the stomata by coloring their guard-cells blue when only these contain amylon, but of course not when the other cells are also filled with that substance. A magnifying power of 150 to 250 diameters is best adapted to well exhibit the stomata.

To find the bast-cells it is necessary to make the thinnest possible transverse sections of the leaf, boil them well, and, if they do not then show under water as bundles of minute, thick-walled darkish cells close to the epidermis, very distinct from the much larger epidermis cells, the application of a solution of caustic potash, to clear the preparation, will readily bring them out. The same magnifying power which we use for the examination of the stomata may be applied for the study of the bast-bundles.

I would advise any one who desires to study the structure of *Isoëtes* leaves to commence with well known species and good (if possible, fresh) specimens, and make himself familiar with the manipulation and with the appearance of their parts under the microscope before he proceeds to study unknown and difficult specimens.

The arrangement of the leaves in the species with two-lobed trunks is at first distichous, and in *I. melanospora* it remains so through life; in all the others the leaves soon enter into a more complicated phyllotactic order; in the larger ones, with many leaves the $\frac{1}{2}\frac{3}{1}$ and even the $\frac{2}{3}\frac{1}{4}$ order is found.

The number of leaves varies from 5 or 10 (*I. pygmæa, I. melanospora*) to 100 or even 200 (*I. Engelmanni,* var. *valida*), and their length from ½–1 inch (in *I. pygmæa*) to 1 or 2 feet (in some forms of *I. flaccida* and *I. Engelmanni*); their color from light and fresh yellowish-green (*I. Engelmanni*) to dark and dull green (*I. lacustris*); their rigidity is greatest in the terrestrial species, and also in some submerged ones; and least in most amphibious species, which often float their leaves on the surface of the receding water, or in some submerged ones, the leaves of which, taken out of the water, collapse like the soft hair of a wet pencil. The submerged species vegetate and retain their verdure throughout the winter (whence, it is said, the name of the genus is derived: *Isoëtes,* equal at all seasons), but the others lose their leaves soon after their maturity in [368 (11)] autumn, some of our terrestrial ones even already in summer.

The broad membranaceous sheathing base of the leaf is without air cavities, stomata, or bast-bundles; in sterile leaves it gradually contracts into the leaf itself. Those leaves are usually sterile which develop at the beginning and the end of the season. The fertile leaves have in their base an excavation which bears the spore-case, *sporangium,* adnate with its back to the midrib. Above this excavation, and separated from it by a deep transverse depression or slit, we find a stipule-like organ of triangular more or less elongated shape, cordate at base, appressed to the leaf, which is termed the *ligula;* it is small, and in not very fresh leaves often mutilated and difficult to make out. The morphology of these parts is obscure, and their diagnostic value not great.

The sporangium is oblong or circular (both forms often seen in the same species), from ½ to 1 line long in *I. melanopoda;* 1 to 2 lines in *I. pygmæa, Tuckermani, echinospora,* and *saccharata;* 1½ to 2½ lines in *I. lacustris, Bolanderi,* and *flaccida;* often a little larger in *I. Butleri* and *Nuttallii;* 2 to 4 lines in *I. riparia, Engelmanni, melanopoda,* and *Cubana;* and in larger forms of *I. Engelmanni* I have seen it 8 to 9 lines long. It is somewhat flattened, and often slightly concave on the ventral side; it is entirely naked, or (the usual case) it is on its sides and principally upwards partially covered by a fold of the ventral side of the leaf-base, the veil (*velum*); in a few species (*I. flaccida, melanopoda,* and *Nuttallii*) this fold extends over the whole sporangium, completely covering it (*velum completum*). The sac of the sporangium is composed of two layers of cells; the outer, epidermidal layer consists of elongated, often variously bent or hooked and curiously interlaced cells, mostly thin-walled and transparent; in some species (e. g. *I. riparia, I. saccharata, I. melanopoda*) groups of brown, thick-walled, (so-called) sclerenchym-cells are mixed with the transparent ones, giving the spore-case a dotted appearance visible even to the naked eye. The spore-case is traversed by numerous parallel strings.

Some sporangia, called *macrosporangia,* contain larger or female spores (*macrospores* or *gynospores*); others are filled with the minute or male spores (*microspores* or *androspores*); these are called *microsporangia.* Almost all the species are monœcious, bearing macrosporangia [369 (12)] on the base of the outer, and microsporangia on that of the inner leaves. I am not aware that any exotic species behave differently, but here we have two species which deviate from this norm. *I. melanopoda* in Illinois as well as in the Indian Territory, from both of which localities I have examined several hundreds of specimens, is polygamous, i. e. monœcious as well as diœcious, and shows about an equal number of male, female, and monœcious plants. The allied *I. Butleri*

is apparently always dicœcious, no monœcious plants having been discovered among about one hundred examined. In *I. melanopoda* I have sometimes seen leaves with microsporangia irregularly interspersed among those that bear macrosporangia.

The macrospores are little spheroid bodies between one-fourth and three-fourths of a millimetre in diameter. Their surface is divided by a circular rim into a lower hemispherical and an upper three-sided pyramidal part, the three faces of which consist of spherical triangles and are separated from one another by three elevated ridges. The crusty surface of these spores, chalky-white or whitish in most species and dusky (when wet black) in *I. melanospora*, is rarely smooth, but generally sculptured and differently marked. The three upper triangles are sometimes marked differently from the lower hemisphere (especially in *I. Tuckermani*) or are smoother than that (often in *I. melanopoda*). To examine the spores well it is necessary to soak the leaf-base, carefully remove some of the wet spores and let them dry on the slide, for they must be examined dry, and best under a power of 50 or 60 diameters; but, to study the sculpture well, a power of 100 to 150 diameters is necessary. With the aid of this we find the macrospores — 1. Minutely tuberculated or warty; the warts small and mostly somewhat depressed, distinct or sometimes somewhat confluent, in *I. pygmæa, Bolanderi, saccharata, melanospora, Butleri,* and *Nuttallii.*

2. With larger, broader tubercles, generally more distant and distinct, but also here and there confluent, worm-like; thus in *I. flaccida, melanopoda,* and *Cubana.*

3. With tubercles elongated into spines; these are simple and very fragile, or here and there confluent and forming sometimes short crests: *I. echinospora* and its forms.

4. With crests and ridges, distinct or anastomosing: *I. lacustris, Tuckermani,* and [370 (13)] *riparia.*

5. The confluent crests form a regular network: *I. Engelmanni.*

The microspores are minute bodies of an ash-gray or a dusky color (dark gray in *I. pygmæa, Bolanderi,* and *melanopoda,* deep brown in *I. melanospora, Butleri,* and *Nuttallii*) and of a somewhat triangular-oblong shape, nearly straight on one and curved on the other two edges, more than half as wide as they are long, between 0.020 and 0.040 millimetres in the longest diameter. Their surface is smooth or minutely papillose or spinulose, the edges smooth or somewhat cristate. Their size furnishes good characters, but the condition of the surface much less so. They ought to be examined under water and with a power of about 400 diameters.

§ 3. Biological Characters.

After the maturity of the spores the leaves wither or rot away, the sporangia decay and set the spores free, which scatter near the base of the plant, often being retained between the matted roots.[4] The cellular mass of the macrospores develops into a *prothallus,* which bursts the spore-case through the opening of three valves which correspond to the three upper faces of the spore, and forms an archegonium, which is fertilized on coming in contact with the zoöspores emitted from the microspores, and thus gives rise to the young plantlet whenever moisture and temperature favor this process.

The germination of the late-maturing water-species probably takes place in the succeeding spring, at least in the more northern localities; in our land and marsh species it may be observed soon after their maturity in summer or in early autumn.

I have studied the whole process in *I. Engelmanni,* which I kept in cultivation for several years. At the end of July the spores were perfectly mature and the leaves were coming off. On the 28th of that month I spread out both kinds of spores on a muddy surface, and kept them slightly

[4] It is therefore proper to examine among the roots for spores whenever none can be found on the plant; one or the other may be discovered there, and help out the diagnosis, which otherwise may rest in obscurity.

covered with water, and fully exposed to the hot sunshine of that season. Three weeks [371 (14)] later the first green points were seen, and continued to come up until the end of October, while at that time the earlier ones had already developed 5 to 8 leaves, $\frac{1}{2}$ to $1\frac{1}{2}$ inches in length. The contents of the large or female spore-cell first developed into a dense cellular mass; this, enlarging, split the cell-coats as above described, and protruded obliquely upwards a minute conical point, green inside, while on the lower edge of the opening, but still between the three valves (the lower hemisphere of the spore-case not being ruptured or perforated at all), a much smaller and rounded knob, the origin of the first rootlet, showed itself, bearing a large number of extremely fine capillary fibres; the bulk of the prothallus remained enclosed in the hemispherical part of the spore-case as a lateral knob, while the first leaf and then the first rootlet elongated; the spore-case was thrown off only when the former had acquired a length of 3 to 4 and the latter one of 2 to 3 lines, the capillary fibres still continuing at the origin of the rootlet. Soon afterwards a second leaf and a second rootlet were formed, both opposite to the laterally protruding spore-mass; after that new leaves and new roots spring up in distichous order between the older ones, the youngest in the centre. In twelve months the young plant, not yet fertile, shows the bilobed flat or rather concave trunk, 2 to 4 lines in diameter, with both ends strongly elevated, their edges already showing small masses of black decayed tissue (the remnants of the first year's growth). The leaves of these yearling plants, 10 to 15 in number, are 3 to 4 inches long, have abundant stomata, but as yet only a single very slender bast-bundle, median on the upper surface.

The species of *Isoëtes*, perhaps 40 to 60 in number (according to the views taken of the different forms, whether species or varieties), are distributed over the whole globe, apparently more abundant in the temperate than in the tropical zones. In North America we have 13 species, with 12 varieties, to which I add one from Cuba; from Mexico we have received as yet none. More are expected to be found when the attention of collectors is more earnestly directed to them.

Most of the species may be called water-plants, growing in stagnant or in slow-running water; a few are always submerged and are found out of water only in abnormal conditions, e. g. in unusually dry seasons. The majority are of amphibious growth, entirely or par- [372 (15)] tially submerged during the wet seasons, in winter and especially in early spring; but at the growing season they partially get out of the water, leaving only their trunk and lower part of the leaves immersed. These species do not come to perfection when completely immersed, though they may not be entirely infertile; it seems that partial exposure to the atmosphere is necessary to their well-being. A variety of the amphibious species are the tidal ones, which are alternately emerged and submerged during the changes of the tides; they are found in the estuaries of some of our Atlantic rivers. Then we have a few species which we are justified in calling terrestrial, as we find them, when fully developed, on dry land; but it seems that for their germination and their growth in early spring they also require moisture and water; we therefore find them on low or flat grounds which may be overflowed in spring, or in springy localities, but they fully develop and become fertile only when out of water. *I. melanopoda*, which belongs to this class, normally matures in June or early in July, and its leaves wither before the end of that month; by keeping it immersed, however, I have kept it fresh and growing throughout the summer, but under these conditions it remained perfectly sterile. Those terrestrial species which grow on arid hills around the Mediterranean must require even less moisture, and are probably satisfied with temporary drenchings.

The submerged and the amphibious species are generally found, some in soft mud, others between gravel and stones; the amphibious ones generally in deep mud. Our terrestrial species grow mostly in heavy, retentive soil.

§ 4. Systematic Arrangement.

Our 14 species can be classed, —

1. According to the development of the trunk: thus we have 13 species, all our North American ones with a *bilobed*, and only the single Cuban one with a *trilobed trunk*.

2. According to their mode of growth: —

a. Submerged species, which normally always grow under water: *I. lacustris, I. pygmæa, I. Tuckermani, I. echinospora*, and *I. Bolanderi*.

b. Amphibious species, which grow in water but have their leaves usually emerged: [373 (16)] *I. saccharata, I. riparia, I. flaccida, I. Engelmanni, I. melanospora*, and probably *I. Cubana*.

c. Terrestrial species, which grow during the greater part of their life on dry (or moist) land: *I. melanopoda, I. Butleri*, and *I. Nuttallii*.

These divisions seemed to be the most natural ones so long as but few species were known, and when other characters, such as the presence or absence of stomata, seemed to correspond with and to confirm them; but since we know more species and more about them, we have learned that structural and biological characters do not always go together; and, moreover, that some species are in some forms submerged and in others almost amphibious (*I. echinospora*), and that some amphibious ones become sometimes almost terrestrial (*I. Engelmanni*). A less important objection is that the biological characters cannot be made out in herbarium specimens.

3. According to the condition of the velum: —

a. A partial or narrow velum in *I. lacustris, I. pygmæa, I. Tuckermani, I. echinospora, I. saccharata, I. Bolanderi, I. riparia, I. Engelmanni, I. Howellii, I. melanopoda*, and *I. Cubana*. In *I. Butleri* the velum is almost completely absent.

b. A complete velum in *I. melanopoda, I. flaccida*, and *I. Nuttallii*.

The anatomical structure of the leaves, viz. the presence or absence of stomata and of peripheral bast-bundles, furnishes us valuable characters, and, though somewhat difficult to ascertain and therefore less practical, may after all have to be placed in the first line, as it seems to correspond best with the essential characters of the plant.

4. According to the presence or absence of stomata on the leaves: —

a. Without any stomata are only *I. lacustris, I. pygmæa*, and *I. Tuckermani*. The typical European *I. echinospora* also belongs here, but the different American forms of this species must be classed among the next, though some of them have only very few stomata, often difficult to make out.

b. With stomata (generally abundant): *I. echinospora* (American varieties), *I. saccharata, I. Bolanderi, I. riparia, I. melanospora, I. Engelmanni, I. Howellii, I. flaccida, I. melanopoda, I. Butleri, I. Nuttallii*, and *I. Cubana*.

5. According to the presence or absence of peripheral bast-bundles: — [374 (17)]

a. Without bast-bundles: *I. lacustris, I. pygmæa, I. Tuckermani, I. echinospora, I. saccharata, I. Bolanderi, I. riparia*, and *I. melanospora*.

b. With bast-bundles: *I. Engelmanni, I. Howellii, I. flaccida, I. melanopoda, I. Butleri, I. Nuttallii*, and *I. Cubana*.

The comparative size or the sculpture of the spores, and the number and length of the leaves, furnish no legitimate grounds for classification; still it may be mentioned here, that the largest macrospores (0.45 to 0.80 mm. in diam.) are found in *I. lacustris, I. Butleri*, and *I. riparia;* the smallest (0.25 to 0.45 mm.) in *I. melanopoda, I. flaccida*, and *I. Engelmanni*, var. *valida*.

The largest number of leaves, 50 to 200, are observed in the last-mentioned form, in *I. melanopoda*, and in *I. Nuttallii;* the smallest number, 5 to 20, in *I. pygmæa, I. melanospora, I. saccharata*, and *I. Bolanderi*.

The longest leaves (15 to 25 inches long) we meet with in *I. Engelmanni*, *I. flaccida*, and *I. Cubana;* the shortest (½ to 3 inches long) in *I. pygmæa*, *I. melanospora*, and *I. saccharata*.

The following classification of our species is proposed as the best I can find, though by no means a faultless one:—

I. Trunk bilobed. — A. Submerged species with quadrangular leaves, without, or in 4 and 5 with few or many, stomata and without peripheral bast-bundles; velum incomplete. 1. *I. lacustris*. 2. *I. pygmæa*. 3. *I. Tuckermani*. 4. *I. echinospora*. 5. *I. Bolanderi*. — B. Amphibious species with abundant stomata in the quadrangular leaves. * Without peripheral bast-bundles (these are intermediate between the submerged and the truly amphibious species.) † Velum partial. 6. *I. saccharata*. 7. *I. riparia*. † † Velum complete. 8. *I. melanospora*. * * With peripheral bast-bundles. † Velum partial. 9. *I. Engelmanni*. 10. *I. Howellii*. † † Velum complete. 11. *I. flaccida*. — C. Terrestrial species, maturing when entirely out of water, with abundant stomata and peripheral bast-bundles in the nearly triangular leaves. * Velum partial or almost wanting. 12. *I. melanopoda*. 13. *I. Butleri*. * * Velum complete. 14. *I. Nuttallii*. [375 (18)]

II. Trunk trilobed, numerous stomata and bast-bundles in the quadrangular leaves; velum partial. 15. *I. Cubana*.

§ 5. Geographical Distribution.

Only a small part of the North American continent has been well explored for Isoëtes, and there, from Massachusetts to the Chesapeake Bay, they appear abundant enough; farther south, and in the whole interior and western part of the continent, they have thus far been found only in a few localities. Some species are quite local, as is the case also with many species of the old world, while others are widely distributed. Our two northern species are identical with, or closely allied to, European forms; all the others are quite distinct from such, so that there is scarcely more than a generic analogy between the species of our middle and southern regions with the Mediterranean ones or those of other regions of the globe.

The old Linnæan *Isoëtes lacustris* is the only species which has been found to extend from the Atlantic to the Pacific States, and it probably occupies a northern belt of the northern hemisphere, though it seems not to have been discovered as yet in Asia. The American forms allied to *I. echinospora*, the other North European species, are the most common in the belt of northern States as far west as Michigan, and have been detected also on the western slope of the Rocky Mountains. Of the others, *I. Engelmanni* extends from Massachusetts to Georgia, and westward to Missouri, though thus far not found anywhere else west of the Alleghany Mountains. *I. flaccida* is peculiar to Florida, and *I. Bolanderi* to the lakes of the western mountain chains, the Rocky Mountains as well as the Sierra Nevada. *I. melanopoda* occupies parts of the Mississippi Valley from Central Illinois to Northeastern Texas, while *I. Nuttallii* is the only species found in the valley of the Columbia River. All the other species seem to be nearly or quite local;— *I. pygmæa*, in the Californian Sierra, but most of them on the Atlantic border. Thus *I. Tuckermani* occurs only near Boston, *I. saccharata* on streams emptying into the Chesapeake Bay, and *I. melanospora* only on that peculiar and botanically so interesting rock, the Stone Mountain of Georgia. Some species which seemed local have lately assumed a little wider range, though yet quite restricted. Among these I mention *I. riparia* of the banks of the lower Delaware River, which occurs also farther north, and *I. Butleri*, first known only from the Indian Territory, now also found in Tennessee. There can be no doubt but that some of the apparently local species will yet be found in a more extended area, when botanists will include in their researches these obscure and inconspicuous plants.

From the warmer parts of North America we know only *I. Cubana*, from Cuba; none have yet turned up from Mexico.

The following table will explain itself:—

	Total species and varieties.	I. lacustris.	paupercula.	I. pygmæa.	I. Tuckermani.	I. echin. Braunii.	robusta.	Bootii.	muricata.	I. Dolanderi.	I. saccharata.	I. riparia.	I. melanospora.	I. Engelmanni.	gracilis.	valida.	Georgiana.	I. Howellii.	I. flaccida.	I. melanopoda.	pallida.	I. Butleri.	immersa.	I. Nuttallii.	I. Cubana.
Greenland	1					1																			
Nova Scotia	1					1																			
Maine	2					1						1													
New Hampshire	2	1				1																			
Vermont	4					1	1					1			1										
Massachusetts	8	1			1	1		1	1			1		1	1										
Rhode Island	2													1	1										
Connecticut	1													1											
New York	3	1				1								1											
Ontario	2					1						1													
Michigan	2	1				1																			
Pennsylvania	4					1						1		1		1									
New Jersey	4					1						1		1	1										
Delaware	3											1		1		1									
Maryland	1										1														
Virginia	1													1											
Georgia	2												1				1								
Florida	1																		1						
Tennessee	1																						1		
Illinois	1																			1					
Iowa	1																			1					
Missouri	1													1											
Indian Territory	2																			1		1			
Texas	1																				1				
Colorado	1		1																						
Utah	2					1				1															
Wyoming	1									1															
Idaho	1																							1	
Washington Territory	2									1														1	
Oregon	2																	1						1	
California	3		1	1						1															
Cuba	1																								1

8 species and varieties have been found in Massachusetts.
4 " " " " " Pennsylvania and New Jersey.
3 " " " " " New York and California.
2 " " " " " 10 States, Territories, or Provinces.
1 " " " " " 15 States, Territories, or Provinces.

§ 6. Enumeration of the Species. [377 (20)]

1. Trunk Bilobed.

A. Submerged, normally growing under water, only in unusually dry seasons coming above the surface; leaves quadrangular, without peripheral bast-bundles; velum incomplete.

* Without stomata.

1. I. LACUSTRIS, *Linn.* Leaves stout, rather rigid, obtusely quadrangular, acute but scarcely tapering, dark or olive-green, 10 to 25 in number, 2 to 6 inches long; sporangium orbicular to broadly elliptical, not spotted, with a rather narrow velum; ligula triangular, short or somewhat elongated; macrospores 0.50 to 0.80 mm.[5] in diameter, marked all over with distinct or somewhat confluent crests; microspores smooth, 0.035 to 0.046 mm. in the longer diameter. — Syst. Veg. I. 1753; Durieu, Bull. Soc. Bot. France, 8, p. 164, 1861; Gray, Man. ed. 5, p. 675.

Var. PAUPERCULA with fewer (10 to 18), thinner, shorter (2 to 3 inches) leaves and smaller spores (macrospores 0.50 to 0.66 mm. diam.; microspores somewhat granulated, 0.026 to 0.036 mm. long).

A northern species of Europe and America, generally gregarious on gravelly soil in the bottom of lakes under 1 to 4 or 5 feet of water, farther south only on mountains; maturing in September and October. Catskill Mountains, N. Y., *Schweinitz;* Echo Lake, Franconia Mountains, N. H., *Tuckerman*, *Engelmann;* in Massachusetts, in Fresh Pond, near Cambridge, *W. Boott*, and Uxbridge, *J. W. Robbins;* Brattleborough, Vt., *C. C. Frost;* Saulte de Ste. Marie on Lake Superior, *Porter and Leidy.* The variety in Grand Lake, Middle Park, Colorado, over 8,000 feet alt., *Engelmann*, and in Castle Lake, near Mt. Shasta, California, 7,000 feet alt., *C. G. Pringle.* — This is the original Linnæan species, formerly confounded with others, and first clearly established by Durieu, l. c. It is always readily recognized by its rigid, rather thick, not gradually tapering dark green leaves, which do not collapse when taken out of the water, and by the size and sculpture of the spores. The variety *paupercula* is based on western mountain specimens, and is characterized by the smaller proportions of all parts, and especially of the (for the species) unusually small micro-

[5] I adopt, for the smaller measurements, the metrical system, which will gradually but surely supersede the old and clumsy method; while, in the larger measurements, as the length of leaves, I still adhere to the foot and inch as the one yet best understood. The millimetre is, as is well known, equal to very nearly half a line.

spores. Durieu, l. c. 11, p. 101, distinguished a form with exceptionally large macrospores (0.70 to 0.80 mm. diam.) as *I. macrospora* from a single specimen from the Herb. Acad. N. S. Philad., with the label "Catskill Mountains" in the handwriting of Schweinitz ; but others show sometimes spores of similar dimensions, e. g. specimens from Lake Superior; and such have also been found in Europe, though there the spores rarely reach a size of over 0.65 to 0.70 mm.

2. I. PYGMÆA, *Engelm.* One of the smallest species, with a few (5 to 10) short (½ to 1 inch long), stout, rigid, bright green leaves, abruptly tapering to a fine point, with very short, often almost square, [378 (21)] epidermis cells ; orbicular sporangium not spotted, with a narrow velum ; macrospores 0.36 to 0.50 mm. thick, marked with minute, rather regular, distinct or rarely confluent warts; microspores 0.024 to 0.029 mm. long, almost smooth and brown. — Am. Naturalist, 8, 214.

Found only once, deeply immersed in a cold alpine stream on the eastern slope of the Mono Pass, California, 7,000 feet alt., *H. Bolander.* — This curious diminutive species is a close ally to the last by the structure of the leaves and the mode of living, but is widely separated from it by the sculpture of the spores ; the shortness of the epidermis cells is quite peculiar to it, and so are the close transverse partitions ; the walls of the leaf and the dissepiments are thinner than in the last, consisting of only a few layers of cells. The minute tubercles of the macrospores are most distinct on the lower surface, but become sometimes confluent on the upper side.

3. I. TUCKERMANI, *A. Braun in litt.* A small plant with very slender, tapering olive-green leaves (10 to 30 in number, mostly 2 to 3 inches long), the outer recurved, walls and partitions rather thick for the diameter of the leaf ; sporangium mostly oblong, white or rarely brown-spotted, the upper third covered by the velum; macrospores 0.44 to 0.56 mm. diam., the upper segments marked with prominent, somewhat parallel and branching ridges, the lower half reticulated ; microspores smooth or nearly so, 0.026 to 0.032 mm. long. — Engelm. in Gray, Man. l. c. 676.

In several ponds and streams near Boston, maturing from August to October; first discovered by *E. Tuckerman*, 1848, in the Mystic River very near where it issues from the pond ; in the same locality and in Mystic, Spy, and Horn Ponds, *W. Boott*, "always immersed in fresh water, sometimes only a few inches below the surface, often in places which are subject to a tide of almost two feet in height, generally gregarious and carpeting the bottom with an olive-green turf." The leaves are usually not longer than two or three inches and, at least the outer ones, recurved ; occasionally, in slender specimens, probably from deep water, I have seen them straighter and over 5 inches long. The sculpture of the spores is very characteristic; wavy, somewhat branching ridges run from the three upper commissures in right angles; on the lower surface they interlace, covering it with an irregular network. Some specimens collected by Mr. Boott at the end of October seem to indicate a second growth, as within the circle of microspore-bearing leaves, and after the outer ones with their macrosporangia had fallen, an inner growth bearing macrosporangia was noticed. One of his specimens is of particular morphological interest, as it shows four heads or leaf-buds from the same healthy and vigorous trunk, three close together on top and a fourth on the side, separated from the others by a deep incision in the trunk. This division of the axis did not result from any proliferation of the leaves, but most probably from a lesion of the centre of vegetation, and is of very rare occurrence in this genus, where the simplicity of the axis is so particularly marked (see above, p. 358).

4. I. ECHINOSPORA, *Durieu.* One of the smaller species, with 10 to 30 or 40 soft bright green or [379 (22)] sometimes reddish leaves, gradually and regularly tapering from a thick base to a very slender elongated point absolutely without stomata, 2 to 4 or sometimes 5 inches long; sporangia orbicular to broadly oval, unspotted, with a narrow velum; macrospores 0.40 to 0.50 mm. thick, densely covered with delicate, erect, truncate, or slightly forked spinules ; microspores 0.030 to 0.034 mm. long, almost smooth. — Bull. Soc. Bot. Fr. 8, 164.

Only in Europe from Northern Italy to Germany, France, and England, extending to Lapland and Iceland, but apparently not in America.

In this country we have a series of forms which have been distinguished by eminent authority, especially on account of the presence of stomata (so various in number and often so difficult to discover) and of a slight difference in the form and size of the microscopic spinules which cover the macrospores. I have thought best to unite them specifically with the European type, though it seems strange that in the European plant stomata should be absolutely absent, and it must remain subject to individual judgment, if not doubt, which view ought to be preferred. Nearest to the European true *I. echinospora* stands the var. *Braunii*, and the other extreme is var. *muricata*, — wide-ranging forms of a single type. The same difficulties, the same doubts, and the same solution we find in studying some foreign forms, and especially those allied to *I. velata* of the south of Europe.

* * Stomata few.

I. ECHINOSPORA, var. BRAUNII, *Engelm.* Rather small, with 13 to 15 green or reddish-green, erect or spreading, rather short (3 to 6 inches long), tapering, soft leaves, generally with few stomata towards the tip only; sporangia orbicular to broadly elliptical, spotted, generally ½ or even ¾ covered by a broad velum ; macrospores 0.40 to 0.50 mm. thick, rarely a little longer, covered with broad, retuse spinules, sometimes somewhat confluent, and

then dentate or incised at tip; microspores 0.026 to 0.030 mm. long, smooth. — Gray, Man. l. c. *I. Braunii,* Durieu, l. c. 11, p. 101.

The most common species of our flora from New Jersey and Pennsylvania northward and northwestward, sometimes on gravelly soil, at other places reported from soft mud, in ponds or slow-running streams, also near the banks of larger lakes or under the influence of tidewater, normally submerged from a few inches to several feet, in dry seasons sometimes getting out of water; associated with *Eriocaulon septangulare, Lobelia Dortmanna, Sparganium, Scirpus, Eleocharis,* etc. New Jersey: in tidewater of Tom's River, a slender long-leaved form, *C. F. Parker, C. E. Smith,* and others; in a lake in Morris Co., *T. C. Porter.* Pennsylvania: Montrose, Susquehanna Co., *A. P. Garber;* Great Lake, Pocono Mountain, *Porter & Canby;* Presque Isle, Erie, *A. P. Garber.* New York: Catskill Mountains in the lake near the hotel, *G. W. Clinton;* Round Lake above Bolton, west of Lake George, on white sand, and in Lake Placide, *L. Lesquereux;* Luzerne Lake and in Niagara River below Buffalo, *G. W.* [380 (23)] *Clinton;* at the head of Goat Island, Niagara, between stones, *G. Engelmann;* Oneida Lake, *J. A. Paine;* in Oswego River, *F. Pursh,* probably (see p. 358). Massachusetts: Mystic Pond near its lower end, gregarious in soft mud in 1 foot of water, also in other parts of the same pond, and in Spot, Spy, and Horn Ponds, on sandy bottom, all near Boston, *W. Boott;* Hammond's Pond, *W. G. Farlow;* Concord Brook, gregarious, on firm bottom, *H. Mann;* Beaver Pond near Beverly, *J. L. Russell;* Uxbridge, in Grafton Pond and several other ponds, *J. W. Robbins.* Vermont: Mt. Mansfield, in the Lake of the Clouds, *C. G. Pringle, H. Mann,* on gravelly bottoms, 1 to 2 feet deep; Lake Dunmore, *A. W. Chapman.* New Hampshire: Lake Winnipiseogee, in mud with *Gratiola aurea, Eriocaulon,* etc., *G. Engelmann* (these specimens were the types of Durieu's *I. Braunii*), *H. Mann, W. Boott;* Echo Lake in the Franconia Mountains (where Mr. Tuckerman and myself had found *I. lacustris*), *W. Boott.* Maine: Moose Lake on Kennebunk River, *C. E. Smith.* Nova Scotia, Shelburne, *T. P. James.* Greenland, in the south, "Tessermint," *I. Vahl* (perhaps this is the true *I. echinospora;* I could not well analyze the small and poor specimen in my possession). Westward the species has been found in Western Canada (Ontario) near Hastings and in a lake northeast of Belleville, on a muddy bottom, *J. Macoun.* Michigan: Bellisle in Detroit River, *H. Gillman.* Utah: lake at the head of Bear River in the Uintah Mountains, at 9,500 feet alt., *S. Watson;* this is the most western and highest, quite isolated, locality known to me.

This form is most closely connected with the European type; the leaves are perhaps not quite so finely tapering; stomata can always be found, at least near the tip of the leaf; the sporangia, white in the type, are spotted with brown sclerenchym cells; the macrospores I cannot distinguish either in size or sculpture; the microspores I find a little smaller. I may state here that the name of *I. Braunii* is preoccupied, as it has already been given to one of the two species of the Tertiary deposits, the well marked spores of which have been discovered in the German Brown Coal strata; Prof. Braun therefore proposed for our plant, if it should eventually be considered distinct, the name of *I. ambigua.*

Var. ROBUSTA, *Engelm.,* similar to the last, but much stouter, with 25 to 70 leaves, 5 to 8 inches long, with abundant stomata all over their surface; velum covering about one-half of the large, spotted sporangium; macrospores 0.36 to 0.55 mm. thick, with the sculpture of the last; microspores the same as in last.

In Lake Champlain, on the north end of Isle La Motte, on a firm sandy soil with silt, in 1 to 2 feet of water, *C. G. Pringle.* Larger and stouter than any form of the last, but principally distinguished from it by the abundance of stomata.

Var. BOOTTII, *Engelm. l. c.* Leaves erect, soft, bright green, fewer (12 to 20), short (4 to 5 inches long); stomata, mostly few, near the tip; sporangia nearly orbicular, pale-spotted, $\frac{2}{3}$ or more covered by the broad velum; macrospores 0.39 to 0.50 mm. thick, with longer and slenderer, delicate, generally simple spinules; [381 (24)] microspores 0.026 to 0.030 mm. long. — *I. Boottii,* A. Braun in litt.

Near Boston, in the Round Pond, Woburn, 2 to 3 feet under water, and in the brook of Tofit Swamp, Lexington, sometimes out of water, *W. Boott.* Very striking on account of the delicate green color of its soft leaves, and the long and slender spinules of the spores.

Var. MURICATA, *Engelm. l. c.* Leaves (15 to 20) long (6 to 12 inches), flaccid, bright green, with very few stomata; sporangium broadly oval, pale-spotted, about half covered by the velum; macrospores a little larger (0.40 to 0.58 mm. thick), with shorter and more confluent, therefore sometimes almost crest-like spinules: macrospores slightly rough on the edges, 0.028 to 0.032 mm. long. — *I. muricata,* Durieu, l. c.

In the shallow and more rapid parts of Woburn Creek, and in Abajona River, the main source of Mystic Pond, near Boston, scattered over a clean gravelly bottom and always submerged, *W. Boott.* Remarkable for its long flaccid leaves and the shorter spinules of the macrospores, which form sometimes crests so that Durieu could compare it with *I. riparia.*

5. I. BOLANDERI, *Engelm.* One of the smaller species, with erect, soft, bright green leaves tapering to a fine point, 5 to 20 or 25 in number, 2 to 4½ inches long, with thin walls and partitions, and generally not many stomata; sporangium broadly oblong, mostly without any spots, with a narrow velum; ligula triangular; macrospores 0.30 to 0.40 or rarely 0.45 mm. thick, marked with minute low tubercles or warts, rarely confluent to wrinkles; microspores

0.026 to 0.031 mm. long, generally spinulose : rarely, in the Rocky Mountain form, smooth, deep brown. — Am. Naturalist, 8, 214. — *I. Californica*, Engelm., name only in Gray, Man. l. c.

A western mountain species, found gregarious in ponds and shallow lakes of the Sierra Nevada of California, northward to the Cascades and eastward to the Rocky Mountains : in little pools on meadows in the upper Tuolumne valley, 9,000 to 10,000 feet alt., on Mt. Dana, on the Mono trail, in Mary's Lake near the summit, 7,000 feet alt., in small lakes about Cisco 4,500 to 5,000 feet alt., "mostly gregarious in mud covering gravel, in 1 or 2 feet of water," *H. Bolander;* Ice Lake, near Soda Spring station, 7,500 feet alt., with *Menyanthes trifoliata, Engelmann;* in many lakes of the high sierras, reported by *A. Kellogg;* on Mt. Adams, Washington Terr., *W. N. Suksdorf;* in the soft muddy bottom of a shallow pond near the falls of the Yellowstone River in Wyoming, nearly covering the muddy bottom, partly emerged near the banks, *C. C. Parry;* in a subalpine lake at Alta, Wahsatch Mountains, Utah, *M. E. Jones*, and in a lake in the Gunnison region, Western Colorado, covering ten acres of ground with *Menyanthes, T. S. Brandegee.* — This species has much the appearance of *I. echinospora*, var. *Boottii*, with its soft, bright green leaves ; the stomata are often difficult to make out.

B. Amphibious, partially emerged, submerged only in the earlier period of their growth or temporarily ; [382 (25)] stomata always present.

* Without peripheral bast-bundles ; intermediate between the submerged and the truly amphibious species.

† Velum partial.

6. I. SACCHARATA, *Engelm.* A small plant, usually with a flat, depressed trunk; leaves subulate, olive-green, spreading, 10 to 20 in number, 2 to 3 inches long ; sporangium oblong, spotted, with a narrow velum ; ligula triangular ; macrospores 0.40 to 0.47 mm. thick, covered with very minute distinct or sometimes a little confluent warts ; microspores papillose, 0.024 to 0.028 mm. long. — Gray, Man. l. c.*

On the banks of the Wicomico, below Salisbury, and of the Nanticoke rivers which empty into the Chesapeake Bay, eastern shore of Maryland, above salt water, scattered on a thin stratum of mud covering a bed of gravel, overflowed by the tides, in company with *Sagittaria pusilla, Eriocaulon, Tillæa simplex, Micranthemum Nuttallii*, etc., *W. M. Canby.* The trunk is in this species unusually flat, about half as thick as it is wide in the direction of the groove ; about one inch of the base of the leaves is pale, and covered with mud agitated by the tides, the upper part is olive-green and when out of water apt to be borne down by mud ; stomata abundant ; macrospores as if sprinkled over with minute white grains of sugar, whence the name.

7. I. RIPARIA, *Engelm.* A larger plant with slender but rather rigid deep green leaves (about 15 to 30 in number), 4 to 8 inches long, rarely longer ; stomata numerous, dissepiments thick, consisting of about 4 layers of cells ; sporangia mostly oblong, distinctly spotted by groups of brown sclerenchym cells, $\frac{1}{4}$ or rarely $\frac{1}{3}$ of it covered by the velum ; macrospores among the largest, 0.45 to 0.65 mm. in diam., marked with jagged crests isolated, or anastomosizing, especially on the lower surface, which thus becomes somewhat reticulated ; microspores more or less tuberculated, 0.028 to 0.032 mm. long. — Flora, Regensb. Mar. 31, 1846 ; Am. Jour. Arts & Sci. 3, p. 52, 1847 ; Gray, Man. l. c.

On the banks of the lower Delaware River between the limits of the tides in mud covering gravel, from Burlington, *T. A. Conrad*, to Wilmington, *W. M. Canby*, and especially about Philadelphia, where *Nuttall* first discovered and *W. S. Zantzinger, E. Durand*, and the later botanists have abundantly collected it, associated with *Elatine, Limosella, Micranthemum, Sagittaria pusilla*, etc. ; also in millponds and still parts of streams in New England, Uxbridge, *J. W. Robbins*, Brattleborough, *C. C. Frost*, and northward, maturing in August and September. — Near *I. lacustris*, with leaves as dark green and almost as rigid, and with spores approaching it in size and sculpture, but readily distinguished by its stomata and by the spots on the sporangium ; from *I. echinospora*, var. *Braunii*, with which smaller forms it may possibly be confounded ; it can always be known by the darker, stiffer leaves, and especially by the character of the spores. Some of the Uxbridge specimens, entirely submerged 2 to 4 feet deep in water, have [383 (26)] slenderer and longer (even 12 inches) leaves. The trunk, mostly thick, I have once found 3-lobed. Germinating spores and young plantlets were found in June by Mr. Durand, indicating germination in spring and early summer.

Farther northward, in Maine, *J. W. Chickering*, and in Canada West, Crow River, Hastings Co., *J. Macoun* (here in running water with *Brasenia* and *Potamogeton*), a form occurs with very few stomata on leaves and apparently two weak bast-bundles, an upper and a lower one, very pale spots on the sporangia and smoothish microspores. This might be designated as var. *Canadensis*, but too little is known about it as yet to form a definite opinion.

* 4. I. SACCHARATA, *Engelm., n. sp.* Leaves (10–15, 2–3 inches long), slender, olive-green, curved ; sporocarps small, ovoid, only the upper edge covered by the velum, nearly unspotted ; macrospores (0.20–0.22 line wide) minutely tuberculate ; microspores (0.012 line long) papillose. — On Wicomico River, eastern shore of Maryland, between high and low tide, *W. M. Canby.*" — (From Gray's Manual, 5th ed. 1868, 676). — EDS.

†† Velum complete.

8. I. MELANOSPORA, *Engelm.* One of the smallest species, with a flat, only slightly bilobed trunk; leaves few (5 to 10, 2 to 2½ inches long), distichous, slender, tapering, light green, spreading; sporangium orbicular or almost obcordate, ½ to 1 line long, entirely covered by the velum, unspotted; ligula short-triangular, obtuse, or about semi-orbicular; macrospores 0.35 to 0.45 mm. in diameter, roughened with distinct or rarely somewhat confluent warts, dark colored; microspores 0.028 to 0.031 mm. long, smoothish or slightly papillose. — Transact. St. Louis Acad. Sci. 3, p. 395 note.*

Stone Mountain, near Atlanta, Georgia, covering the bottom of shallow excavations on the naked granite surface, a few inches deep and a few feet in diameter, holding about one inch of light, black soil, and at best a couple of inches of water supplied only by rains and dews, and completely dried up and baked for weeks or months under the action of the glaring southern sun on the bare rock, when only the little shrivelled trunks with their black withered matted roots remain, to revive under a fresh supply of autumnal rains (with *Amphianthus pusillus*), discovered by *W. M. Canby*, observed since by *A. Gray* and myself; maturing in May and June. A cake of them taken home with me began to sprout soon after being moistened, and, vegetating in the room through winter, fully developed in early summer, and afforded a fine opportunity for studying this curious little species, interesting on account of its native locality, its endurance of drought, its mode of growth, and the phyllotactic arrangement of its leaves, its entire velum and its dark spores; it seemed to thrive best when only the base of the leaves was covered with water. The trunk is unusually flat and only slightly grooved underneath and on one side, only about ½ to 1 line thick and 2 to 4 lines in the longer and not much more than half as much in the shorter diameter; distichous leaves soft and slender, their dissepiments consisting of only two layers of cells. The sporangia, ½ to ¾ line wide, readily separate from the leaf-bases, so that they are sometimes found adhering to the trunk after the leaf itself has already fallen away. The macrospores, only 8 to 20 in each sporangium, are black when moist and dark gray when dry; in some I [384 (27)] find the warts much smaller than in others, but never wanting; microspores also quite dark brown.

** With peripheral bast-bundles.

† Velum partial.

9. I. ENGELMANNI, *A. Braun.* Our largest species, with numerous (25 to 100) long (9 to 20 inches or more) light green leaves, with abundant stomata; sporangium usually oblong to linear-oblong, unspotted; velum narrow; ligula elongated from a triangular base; macrospores 0.40 to 0.52 mm. thick, delicately honeycomb-reticulated; microspores 0.024 to 0.028 mm. long, generally smooth. — Flora, l. c.; Am. Jour., l. c.; Gray, Man. l. c.

Var. GRACILIS, *Engelm.* Often submerged, with fewer (8 to 12) leaves, 9 to 12 inches long; the bast-bundles sometimes quite small, or only two of them. — Gray, Man. l. c.

Var. VALIDA, *Engelm.* The stoutest of all our species; leaves 50 to 100 or even 200, 18 to 25 inches long, keeled on the upper side; sporangium often linear-oblong (4 to 9 lines long), ⅓ or often ½ or even ⅔ covered by the broad velum; macrospores rather smaller, 0.32 to 0.48 mm. thick; microspores 0.024 to 0.027 mm. long, spinulose. — Gray, Man. l. c.

Var. GEORGIANA. Similar to the type; leaves few (in the only specimens seen 15, 10 to 12 inches long), rather slender; oval sporangium with narrow velum; macrospores larger, 0.48 to 0.56 mm. thick; microspores 0.028 to 0.031 mm. long, smooth.

In ponds and ditches, immersed in mud, rarely found in slow-running streams, in company with the ordinary vegetation of such localities, *Bidens*, *Polygonum*, *Lycopus*, *Carices*, *Leersia*, etc.; mature in summer; probably throughout the Middle States, but thus far only found — from Massachusetts: Arlington Brook, Alewife Brook, West Cambridge Brook, Woburn, *W. Boott.* Rhode Island: Newport, *W. G. Farlow.* Connecticut: Meriden, *F. W. Hall* — to New York: Peekskill, *W. H. Leggett.* New Jersey: *E. Durand*, *C. F. Austin*, and others. Pennsylvania: Bethlehem, *C. J. Moser*, *E. Durand*, *F. Wolle;* Delaware Water-Gap, *S. W. Knipe;* Darby, *J. G. Hunt;* Philadelphia, *E. Durand*, *C. E. Smith*, and others. Delaware: *W. M. Canby*, *A. Commons.* Virginia: Salt Pond Mountain, with *Parnassia asarifolia*, *W. M. Canby.* Missouri: St. Louis, *N. Riehl*, and *G. Engelmann*, 1842, in a single locality, where it was soon afterwards destroyed by cultivation: not found otherwise west of the Alleghany Mountains. Var. *gracilis* seems to be a northern form: Brattleborough, in Clark's Pond, *C. C. Frost;* Colebrook's, in a shallow stream with gravelly bottom, *J. W. Robbins;* New Haven, in fresh water on a tidal shore, *D. C. Eaton;* Newport, *Bridges*, *G. Thurber;* Passaic River, near low-water mark, *J. Ennis.* Var. *valida* was discovered in Pennsylvania near Warrior's Mark, Huntington Co., and Smithville, Lancaster Co., *T. C. Porter;* and in Delaware, Wilmington, *W. M. Canby.* Var. *Georgiana* comes from a mountain stream, Georgia, the Horseleg Creek, a tributary of [385 (28)] Coosa River, Floyd Co., in slow-flowing water about a foot deep, *A. W. Chapman.*

The trunk of this species is larger than I have seen it in any other, and more variable in form; sometimes it is quite flat and over one inch wide, especially in var. *valida*, or it is thick; and I have seen it even twice as high as it was wide, 4½ lines wide in the largest transverse diameter, and 7 lines high; this, however, is a very unusual form.

* The original description is reproduced above, pp. 401, 402. — EDS.

The plant is submerged in spring with the leaves partly floating; later, when the water recedes, the older leaves are spread out on the mud, but the later growth becomes erect; var. *gracilis* is often more or less submerged, and its weakly development is probably owing to this circumstance, while var. *valida* is the stoutest form we have, and one of the stoutest in the whole genus, perhaps only *I. Malinveriana* of the rice fields of Lombardy surpassing it. A very small form, only 5 inches high, has been collected in a springy place on a rocky hillside near Wilmington, Del., by A. Commons, otherwise not distinct. The Georgia variety, characterized by its larger spores, ought to be further studied. In my Missouri specimens I find, among many of the ordinary type with white sporangium, a few where this organ is uniformly brown, not spotted. The dissepiments of the leaves consist, the median of 3 to 4 and the transverse one of 2 to 3 layers of cells. The well-marked reticulation of the macrospores is formed of very thin, fragile laminæ, not of thick ridges as in some other species.

10. I. Howellii, *Engelm, n. sp.* Middle-sized, leaves (10 to 25) bright green (5 to 8 inches long) with thick dissepiments; sporangium oval (1½ to 2½ lines long), unspotted, ¼ to ½ covered by the velum; subulate ligula as long as sporangium; macrospores 0.43 to 0.48 mm. in diam., rough, with prominent rounded single or sometimes confluent tubercles.

On border of ponds at the Dalles of the Columbia, Oregon, *J. & T. J. Howell*, 1880, not quite mature in June. I insert this species, which has just been communicated to me through the kindness of Mr. G. E. Davenport, while the manuscript is in the hands of the printer; this must excuse some discrepancies in the foregoing pages, where no reference could be made to it. The new species is distinguished from the similar *I. Bolanderi* by the longer leaves, larger, more prominently marked macrospores, and especially by the distinct peripheral bast-bundles, which place it near the foregoing one, by the thick dissepiment consisting of 4 to 6 layers of cells, and by the unusually narrow and long ligula; the tubercles of the spores are quite prominent, as high as they are wide, rounded at top; microspores light brown, smooth. — Among the specimens of this species, and probably collected with it, I find a single one similar in the structure of the leaf, but without a trace of a velum, the sporangium being entirely naked, and only attached by the median line to the leaf base; it is unfortunately immature, and can only be indicated as a probably new species, *I. nuda.* This would not be the first instance of two species growing together in the same pond or lake; in Mystic Pond we find *I. Tuckermani* and *I. echinospora*, var. *Braunii*, in Echo Lake the [386 (29)] latter and *I. lacustris*, and in Europe not rarely this together with *I. echinospora.*

†† Velum complete.

11. I. flaccida, *Shuttleworth, in sched.* A slender plant of light green color; leaves often very long, 10 to 35 in number, 15 to 24 inches long, sometimes entirely submerged, or partly floating on the surface, or entirely emerged; sporangia oval, 2 to 3 lines long, entirely covered by the velum; macrospores 0.30 to 0.42 mm. in diam., covered with many or rarely few comparatively large flattish tubercles, distinct or confluent into labyrinthiform wrinkles; microspores not seen. — A. Braun in Flora, l. c.; Amer. Jour. l. c.; Chapm. Fl. So. States, p. 602.

Var. rigida, a smaller form with still more slender, erect, dark green leaves (about 10 to 15 in number, 5 to 6 inches long).

Var. Chapmani, larger, light green leaves floating (about 30, 18 inches long); sporangium orbicular; spores larger, macrospores 0.44 to 0.55 mm. in diam., marked as the type, or, especially on the upper side, almost smooth; microspores 0.027 to 0.030 mm. long, slightly papillose.

Florida, on the muddy bottom of lakes or swamps, first found by Dr. Rugel in Lake Immonia, north of Tallahassee; lately rediscovered by A. P. Garber in a hummock, near Manatee, on the muddy border of shallow ponds in water from a few inches to 1½ feet deep, the long leaves floating or spread out on the mud, the inner ones erect; mature in April and May, disappearing in June. Var. *rigida* was found by the same collector on the wet borders of Lake Flirt, not far from Lake Okeechobee, in August, entirely emersed and erect. Mr. A. H. Curtiss seems to have met with a similar form in a muddy swamp on Indian River; not one of all these had any mature microspores. Var. *Chapmani* was discovered by A. W. Chapman near Mariana, West Florida, filling a lakelet of pure limestone water about one foot deep, formed by one of those (in that region so common) subterranean streams, where it comes to the surface before emptying into Chipola River, together with *Nasturtium lacustre;* but the *Isoëtes* has not been seen in it since: its larger macrospores, sometimes quite smooth, distinguish it from the other forms. — This peculiar species, the only one thus far found in Florida, is distributed over the whole State. It cannot be classed with the submerged species, for, though evidently often in deep water, the leaves elongate, seek the surface and float on it. The closed velum and the peculiar sculpture of the macrospores readily distinguish it from its allies.

C. Terrestrial species, maturing when entirely out of water, with abundant stomata and peripheral bast-bundles, thick dissepiments, and small air cavities in the nearly triangular leaves.

* Velum partial or almost wanting.

12. I. melanopoda, *J. Gay.* Polygamous; trunk subglobose, deeply bilobed; leaves slender, stiff, erect, bright green, usually black at base (15 to 60 in number, 5 to 10 or rarely even 18 inches long); sporangia mostly

oblong (2 to 4 or even 5 lines long), spotted, with narrow velum, ligula triangular-subulate ; macrospores [387 (30)] among the smallest in the genus, 0.25 to 0.40 mm. in diam., with depressed tubercles often confluent into worm-like wrinkles, or almost smooth ; microspores also smaller than usual, 0.023 to 0.028 or rarely 0.030 mm. long, spinulose. — Durieu in Bullet. l. c.; Gray, Man. l. c.

Var. PALLIDA. A larger plant, leaf-bases pale, velum usually much broader, covering ¼ or ⅓ of the sporangium ; macrospores only 0.30 to 0.35 mm. thick.

An exclusively western species, in low prairies and fields overflowed with at least one inch of water in spring, or in shallow ponds which dry up in summer, in stiff clayey soil, in company with the ordinary vegetation of such localities, e. g. *Nasturtium sessiliflorum, Hypericum mutilum, Elatine, Penthorum, Ludwigia, Ammannia, Alisma, Juncus*, etc., from Northern and Central Illinois, Ringwood, *G. Vasey;* Athens, Menard Co., *E. Hall;* to Clinton, Iowa, *G. Vasey*, the Indian Territory, in low places in the saline flats near Limestone Gap, *G. D. Butler*, and to the wet pine woods in Hempstead Co. and about Houston, Texas, where the variety occurs, *E. Hall.* Maturing in June or beginning of July. — Mr. Hall was accidentally led to the discovery of this plant on his farm in 1853 by finding its trunks and spores in turning up the soil for brick-making ; he has since made many interesting observations about it ; he does not find it every year: thus in 1877 there was none at all in localities where before and since it abounded, though the season was wet ; another time he found it copiously only in plough furrows in a meadow, and not elsewhere ; in wet seasons, when the water is deeper than usual about the plants, the leaves become longer, more flaccid, and even decumbent, and the spores mature later or not at all. In ordinary seasons the leaves disappear entirely in July, and nothing but the trunks remain, and about them the numerous spores, both of which are eagerly sought after by mice and other animals. The spores germinate whenever sufficient rain falls in the later summer months, and perfect meadows of young plantlets can be observed in wet autumns. Sometimes the plants are seen as fresh in September as in May, and already 4 to 6 inches high, and in 1865 they were so much favored by the season that a second crop was gathered in November with perfectly mature spores ; but it is scarcely probable that these could have been seedlings of the preceding summer, though Mr. Hall is inclined to think so.

The polygamous character of this species has been alluded to on page 369. I will here only add, that a number of monœcious specimens show a preponderance of one or the other sex, and that in a few I have found leaves, which bear male or female sporangia, irregularly mixed.

The dissepiments of the leaves consist of 6 to 9 layers of cells, the lower median being the thickest. Besides the normally 4 peripheral bast-bundles we find here often several smaller accessory ones, which increase the rigidity of the leaves. In no species have I seen the macrospores so variable in size in the same sporangium ; [388 (31)] large and small ones are indiscriminately mixed ; and they are also remarkably variable in their sculpture, showing distinct or confluent vermiculate tubercles, or a nearly smooth surface ; the dividing ridges or commissures are very prominent and smooth. The leaf-bases of the typical form of this species are black and shining, and justify the name given by that zealous botanist Jacques Gay, who in his seventy-fifth year was still anxious and able to climb the high mountains in the centre of France, to study in their lakes the two European species which had just then become prominent through the labors of his friend Durieu de Maisonneuve, and who left us such a vivid description of his hardships, excitements, and pleasures on that trip (Bull. S. B. F. vols. 8 & 9) ; death prevented him from publishing it, but his name remains connected with it. Now and then a paler specimen is seen, and the Texan form is always pale, and distinguished also by its broader velum.

13. I. BUTLERI, *Engelm.* Dicœcious, smaller than the last, with a subglobose trunk and thinner and more rigid bright green leaves, 8 to 12 in number and 3 to 7 inches long ; sporangium usually oblong, spotted, without any or with a very narrow velum ; ligula subulate from a triangular base ; macrospores larger than in last, 0.50 to 0.63 mm. in diameter, similarly marked with knobs or warts, distinct or sometimes confluent ; microspores 0.028 to 0.034 mm. long, dark brown, papillose. — Bot. Gazette, 1878, p. 1.

Var. IMMACULATA. Larger, leaves sometimes as many as 60, 6 to 9 inches long ; sporangium without spots ; macrospores rather smaller, 0.40 to 0.56 mm. in diam. ; microspores 0.029 to 0.031 mm. long, spinulose.

In the saline flats (called alkali flats, but impregnated with sulphates) of the Indian Territory, near Limestone Gap, between Arkansas and Red rivers, associated with the few coarse plants which can live in those localities overflowed in winter and spring, and baked hard in summer and autumn, such as *Iva angustifolia, Ambrosia psilostachya, Arenaria Pitcheri*, and with *Isoëtes melanopoda*, but in rather drier localities than this ; maturing in May and June, *G. D. Butler.* The variety near Nashville, Tenn., in cedar barrens, in damp places on the limestone flats, with *Leavenworthia, Talinum, Sedum pulchellum, Schœnolirion*, several *Junci*, etc., *A. Gattinger.* — This species, also peculiar to the Mississippi Valley, is quite unique in this genus by its dioicity, though its nearest ally, the last-mentioned one, approaches it. From this it is readily distinguished by the absence of the velum, by the deep brown color of the microspores and the larger size of the macrospores ; in these last I notice the peculiarity that the ridges themselves which separate the faces of the spores are also more or less tuberculated, while in other species they are quite smooth.

* * Velum complete.

14. I. NUTTALLII, *A. Braun in herb.* Similar to the last two species, with an almost globose, slightly grooved trunk and 20 to 60 slender bright green leaves, 3 to 9 inches long, with only 3 peripheral bast-bundles; sporangium oblong or oval, entirely covered by the velum; macrospores very variable in size, between [389 (32)] 0.25 and 0.50 mm. thick, densely covered with minute but prominent rounded warts, or, rarely, almost smooth; microspores 0.025 to 0.028 mm. long, papillose, brown. — Engelm. in Am. Nat. 8, p. 215. *I. opaca*, Nutt. in Hb. Ac. Phil.

On damp prairie flats or springy declivities in the valley of the Columbia River, *Nuttall;* abundant about Silverton in the Willamette valley, *E. Hall*, No. 693; at Milwaukee, Oregon, *J. Howell* (with almost smooth macrospores); Klickitat Co., Washington Terr., on Kamass Prairie and at the base of Mt. Adams, 2,100 feet alt., *W. N. Suksdorf;* eastward on Kamass Prairie of the Cœur d'Aleines in Western Idaho, *C. A. Geyer.* — The closed velum and the much smaller warts of the macrospores distinguish this readily from the two other terrestrial species; it is the only species on which I observe constantly only 3 peripheral bast-bundles, one on each of the three edges, the upper middle one being absent. The median dissepiment of the leaves consists of 8 or 9 and the transverse one of 6 to 7 layers of cells.

II. TRUNK TRILOBED, bast-bundles and numerous stomata in the quadrangular leaves; velum partial.

15. I. CUBANA, *Engelm.* One of the larger species; leaves 30 to 40, 15 inches long, fresh green, with 6 bast-bundles; sporangia oblong, unspotted; velum very narrow; macrospores 0.30 to 0.40 mm. thick, marked with coarse, round, depressed, never confluent tubercles; microspores 0.024 to 0.027 mm. long, papillose, pale. — Sauvalle, Fl. Cub., p. 203, name only.

On the bottom of rivulets in the pine woods of Eastern Cuba, *Chas. Wright*, probably floating. — This is the only American species north of the Equator with a trilobed trunk; it compares most closely with the East Indian *I. Coromandelina* according to A. Braun's observation. The roots form 3 distinct bundles from the 3 grooves; the bast-bundles are found at the four intersections of the dissepiments with the outer walls and at the two upper edges of the leaf.

TABULATED CHARACTERS OF THE NORTH AMERICAN ISOËTES.

	Vegetation.	Trunk lobes.	Leaves. Number.	Leaves. Length in Inches.	Stomata.	Bast-bundles.	Velum.	Sporangium.	Macrospores. Diameter. Millimetres.	Macrospores. Surface.	Microspores. Length. Millimetres.	Microspores. Surface.	Native Country.
1. *I. lacustris.*	subm.	2	10–25	2– 6	0	0	*n.*	*w.*	0.60–0.80	Cristate.	0.035–46	Smooth.	Northern New York to Lake Superior.
var. *paupercula.*	"	2	10–18	2– 4	0	0	*b.*	*w.*	0.62–0.66	"	0.026–36	Nearly do.	Rocky Mountains and California.
2. *I. pygmæa.*	"	2	5–10	½– 1	0	0	*n.*	*w.*	0.36–0.50	Minutely tuberculated.	0.024–29	"	Californian Mountains.
3. *I. Tuckermani.*	"	2	10–30	2– 3	0	0	*b.*	*sp.*	0.44–0.56	Cristate above, reticulate below.	0.026–32	Smoothish.	New England.
4. *I. echinospora*, var. *Braunii.*	"	2	15–30	3– 6	few.	0	*b.*	*sp.*	0.40–0.50	Spinulose.	0.026–30	Smooth.	Pennsylvania northward and northwestward and to Utah.
var. *robusta.*	"	2	25–70	5– 8	many.	0	*b.*	*sp.*	0.36–0.55	With longer slenderer spines.	0.026–31	"	New England.
var. *Boottii.*	"	2	12–30	4– 5	few.	0	*bb.*	*sp.*	0.40–0.50	With longer slenderer spines.	0.026–30	Smoothish.	" "
var. *muricata.*	"	2	15–30	6–12	"	0	*bb.*	*w.*	0.44–0.58	With shorter confluent spines.	0.028–32	"	" "
5. *I. Bolanderi.*	"	2	5–20	2– 4½	"	0	*b.*	*w.*	0.30–0.45	Sparsely and minutely tuberculated.	0.026–31	Papillose.	California, Oregon, and Rocky Mountains.
6. *I. saccharata.*	amph.	2	10–20	2– 3	many	0	*n.*	*sp.*	0.40–0.47	Minutely tuberculated.	0.024–26	"	Maryland.
7. *I. riparia.*	"	2	15–30	4– 8	"	0	*b.*	*sp.*	0.44–0.65	Cristate.	0.028–34	"	Pennsylvania to New Engl'd.
8. *I. melanospora.*	"	2	5–10	2– 2½	"	0	*c.*	*w.*	0.35–0.45	Minutely tuberculated.	0.027–30	Smoothish.	Georgia.
9. *I. Engelmanni.*	"	2	25–100	9–20	"	4	*n.*	*w.*	0.40–0.52	Reticulated.	0.024–28	"	Delaware to New England and Missouri.
var. *gracilis.*	"	2	8–12	9–12	"	4	*n.*	*w.*	0.38–0.48	"	0.024–28	"	Pennsylvania to New Engl'd
var. *valida.*	"	2	50–200	18–25	"	4	*b.*	*w.*	0.32–0.48	"	0.024–27	Spinulose.	Pennsylvania.
var. *Georgiana.*	"	2	15	10–12	"	4	*n.*	*w.*	0.48–0.56	"	0.028–31	Smooth.	Georgia.
10. *I. Howellii.*	"	2	10–25	5– 8	few.	4	*b.*	*w.*	0.43–0.48	Coarsely tuberculated.	.....	.....	Oregon.
11. *I. flaccida.*	subm.?	2	10–35	15–24	many	4	*c.*	*w.*	0.30–0.42	Coarsely tuberculated, tub. often confluent.	.....	.....	Florida.
var. *rigida.*	amph.	2	10–15	5– 6	"	4	*c.*	*w.*	0.30–0.38	do. often confluent.	.....	.....	"
var. *Chapmani.*	"	2	30	18	"	4	*c.*	*w.*	0.44–0.55	do. often smooth above	0.027–30	Papillose.	"
12. *I. melanopoda.*	terr.	2	15–60	5–16	"	4+	*n.*	*sp*	0.25–0.40	" " " "	0.023–30	Spinulose.	Illinois to Indian Territory.
var. *pallida.*	"	2	10–15	8–15	"	4	*b.*	*sp.*			.....	.....	Texas.
13. *I. Butleri.*	"	2	8–12	3– 7	"	4	*nn.*	*sp.*	0.50–0.63	Minutely tuberculated.	0.025–34	Papillose.	Indian Territory.
var. *immaculata.*	"	2	20–60	6– 9	"	4	*nn.*	*w.*	0.40–0.56	do. or nearly smooth	0.029–31	Spinulose.	Tennessee.
14. *I. Nuttallii.*	"	2	15–60	3– 9	"	3	*c.*	*w.*	0.32–0.52	Minutely tuberculated.	0.025–28	Papillose.	Western Idaho to Oregon.
15. *I. Cubana.*	amph.?	3	30–40	15	"	6	*n.*	*w.*	0.30–0.40	Coarsely tuberculated.	0.024–27	"	Cuba.

EXPLANATIONS. — VEGETATION — submerged, amphibious, or terrestrial. VELUM — *n.* means narrow; *nn.*, very narrow; *b.*, broad; *bb.*, very broad; *c.*, closed. SPORANGIUM — *w.* means white or unspotted; *sp.*, spotted with dark sclerenchym-cells.

XII.

SHORTER MISCELLANEOUS PAPERS.*

I. REMARKS ON NELUMBIUM LUTEUM.

From the Transactions of the St. Louis Academy of Science (Proceedings), Vol. II. 1860.

The *Nelumbium*, common in our stagnant waters, is not only one of our most showy [136] plants, with the largest leaves and the largest flowers, with edible nuts and large edible tubers; but it is also one of the most curiously constructed plants, following with astonishing regularity its peculiar but very simple laws. Its morphology has attracted the attention of botanists before this, and Mr. A. Trécul has done much to develop its peculiarities; Prof. Caspary has studied the plant very intelligently, without, however, publishing as yet anything about it. The ample material at my disposal has, I believe, permitted me to add observations which may have been beyond the reach of my predecessors.

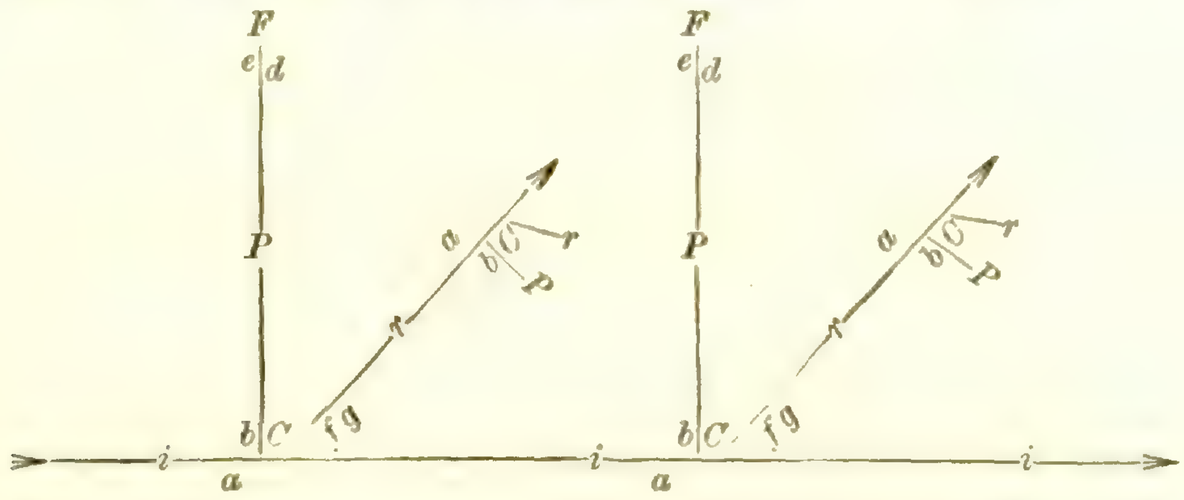
The structure of the embryo is sufficiently well known. The lower leaf (always on the side of the rhaphe and the periphery of the torus) of the large green plumule shows at the base of its petiole a rim, extending around the stemlet, indicative of the stipule which characterizes all the succeeding leaves. The stipule of the second much smaller leaf includes the third, and the stipule of this a fourth leaf, all of them preformed in the seed. After these distichously arranged leaves have been developed, the young stem reclines in the mud, and henceforth begins the new mode of vegetation which ever afterwards characterizes this plant. The stem, growing now horizontally in the mire at the bottom of the pond or lake, has an upper, or dorsal, and a lower, or ventral side; it (as well as the organs produced from it in a vertical direction) has an anterior and a posterior side in regard to the direction of its growth. This stem is terminated by a bud, which consists of two bud-scales (Niederblaetter), *a* and *b*, in opposite directions, with very short, confluent nodes, and one large leaf, *C*, with the stipule, *s*, in the direction of the second scale, succeeded by an elongated internode, *i*, which at its end bears a similar bud. The roots consist of numerous fleshy fibres, beset with simple fibrillæ, and originating from the node just behind the lowest scale.

Now, the plant prepares for propagation also in the simplest and most constant manner: one flower is produced from the axil of the second scale and one branch from that of the leaf; [137] these parts are always preformed and distinctly visible even when not developed. The long and stout flower-stalk, *P*, without any foliaceous organs at its base, bears on its top the flower *F*, and just under it two opposite bracts, *d* and *e*, — the lower one, *d*, having a direction opposite to the supporting scale, *b*. The branch, *r*, has at the base of the long internode and opposite to the supporting leaf two bud-scales, *f* and *g*, one above the other; the internode is terminated by a bud

* Arranged systematically.

exactly like the one described before; so, however, that the scale *a* has a direction opposite to that of *f* and *g*; consequently, *b* with *P* and *C* with *r* have the same direction as *f* and *g*.

The following diagram will explain the arrangement and the repetition of the different organs:



STEM. — The long internode, not quite cylindrical, but depressed and somewhat channelled above, is traversed by 6–9 principal air channels or tubes, of unequal size, arranged in a circle, with numerous smaller peripheral and one central one. The nodes are almost solid, but beyond them, in the next internode, the tubes are continued even with their irregularities and peculiarities, adding new ones when the plant becomes stouter. In both axillary productions, the peduncle and the branch, the arrangement of the tubes is reversed. In the full-grown plant the internode is commonly 12–20 inches long and 5–8 or even 9 lines in diameter. I usually find a pair of small tubes above, 2 or 3 pairs of large ones on the sides, and a single middle-sized tube below. In the embryo a pair, sometimes more or less confluent, occupies the side of the lowest leaf, an odd one the side of the second leaf, and 4 or sometimes 5 others the intervening spaces. The stem of smallest size has a small pair above, a large pair on the sides, and a middle-sized pair below; in larger stems a seventh odd tube appears between the lowest pair, and in full-grown ones an upper pair of small ones completes the circle of nine tubes. In the peduncle the same system of tubes is reproduced (not always so regular) in an inverse order, so that the small pair is found on the anterior side, or on the side opposite its supporting scale. The branch has at first always six tubes, the smallest pair on the lower side opposite to the supporting leaf. This arrangement, however, is usually only visible near the origin of the branch, because the upward tendency of the developing leaf and flower, which in the bud are directed downwards, imparts to the tender, growing shoot a rotation half around its axis, thus righting themselves, and bringing, in the anterior part of the internode, the pair of small tubes to the upper side. Where circumstances, such as hardness of soil in very dry seasons, prevent this rotation or twist, the different organs curve from under the branch upwards to the light. As the branch grows, more tubes are added in the succeeding internodes, just as in the parent stem, from which henceforth it does not differ at all, shooting up a flower and a leaf at each repetition of its simple cycle, and gradually overrunning the whole bottom of the pond with their network.

Thus the plant continues to grow until some time in August, after the flowering period is passed, it prepares for winter by depositing in the now shortened and thickened internodes or [138] joints a large quantity of starch as food for the young plants, which in the succeeding season spring from the terminal bud at the tip and the axillary bud at the base of the tuber. These tubers are 5–10 inches long, 1–2 inches in diameter, somewhat spindle-shaped, depressed, and not rarely angled and furrowed, and weigh 2–8 ounces; they are traversed by the same system of tubes as the summer stems; the tubes, however, are mostly of a more irregular shape and more or less compressed. Our plant having no truly perennial rootstock like its relatives, the *Nymphæaceæ*, the tubers and their buds are the only parts which live through winter, much like those of the potato.

LEAVES. — All the foliaceous organs, with the exception of those in the flower proper, are either distichously alternate, or they are superimposed in the order detailed above. The lowest scale, *a*, is

about 3 inches long and envelops the whole bud ; the growing stem, enveloped by the stipule, bursts through its very thin back, while the leaf and the flower-bud, wrapped in the second scale, *b*, pass out on the upper, open side, leaving its upper part, when entire, between the leaf and the stipule ; at last, it usually divides into two halves, with lateral positions.

The second scale, *b*, is 3–5 or sometimes even 6–8 inches long, bears in its axil *always* the flower-bud, and originally envelops that and the leaf, but not the stipule ; it remains on the back of the peduncle, or, where that remains undeveloped, of the petiole.

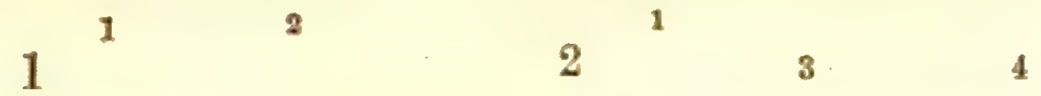
The peltate, orbicular leaf, *C*, has often been described. I allude here only to the 6 tubes of its stalk, arranged exactly as in the smallest branches, the smallest pair on its *posterior*, *grooved* side. The epidermis-cells of the upper surface are very small (0.007–0.010 line diameter) and angular, each with a little knob, which together produce the velvety, water-repelling surface; the lower surface is formed of a single layer of much larger cells (0.020–0.025 line) with tortuous walls, and is kept distended and separate from the parenchym of the leaf by a kind of framework built of cells, which forms a network of meshes filled with air. Only the upper surface has stomata. At the base of the leaf a stipule, in shape and texture similar to the scales, in full-sized specimens 2–2½ inches long, envelops the axillary bud as well as the continuation of the stem ; while the latter, growing out, leaves it on its upper side, the branch penetrates its back, thus placing it between itself and the stem, or at last splits it in two.

The first opposite leaves of the flowering branch may be classed as bracts ; from the very similar exterior sepals, they may be distinguished by their position, smaller size, and persistency ; they are already observed in the smallest bud, of 0.1 line diameter. The succeeding organs of the flower are arranged in much more complicated phyllotactic orders.

The lowest, superimposed scales of the leaf-branch are close between the branch and the stem ; the lowest one is only 6–9 lines long, notched or unequally bifid ; the second is 1½–2 inches long, of the form and texture of the other scales, not perforated by any organ, but often at last severed in two halves.

Flower and Fruit. — A few observations must suffice here. I will only mention that the prolonged and thickened commissure of the anthers forms a hook, which in the bud is curved over the torus, that of the inner filaments much more than that of the outer ones. The pollen grains are smooth and globular, 0.04 line in diameter. I find the number of carpels, and consequently of nuts, on the torus between 12 and 31, arranged in two or in three circles: 9–15 in the outer, 3–11 in the second, and 1–5 in the third circle, when present. The carpels, in the smallest flower-buds examined, were indicated by cellular protuberances on the receptaculum in the same plane as the smaller cellular masses destined for anthers, of 0.05 line diameter; the torus, growing up, gradually encloses them, leaving only the stigma free. The knob of the carpel is always directed towards the periphery of the torus, and the micropyle of the anatropous ovule towards the centre ; the channel of the perforated stigma leads into the cavity of the carpel near the short funiculus, away from the micropyle. The cotyledons form with the edge towards the rhaphe, consequently in the radius of [139] the torus, and the lowest leaf of the plumula turns its back to the rhaphe and the periphery.

Buds. — The buds, especially those which persist through winter, include the whole plant with all its organs (except the complicated parts of the flower itself) completely preformed, and repeated several times. A bud of 2 inches in length contained the primary organs *a*, *b* and *C* four times, and the branch *r* twice repeated, the first branch consisting of two internodes, thus : —



In 1 the leaf was 20 lines long; in 2, 3 lines; in 3, ⅔ line, and in 4, ⅙ line long; each one of the seven cycles distinctly showed the flower-bud and the branch-bud at their proper places.

PHYLLOTAXIS. — The attempt to harmonize the very unusual disposition of the organs with the ordinary laws of phyllotaxis has produced some very odd theories. A rather specious explanation seems to be the following: the flower might be the termination of the main stem, which has five distichous foliaceous organs, *C*, *a*, *b*, *d*, and *e*; the lowest leaf, *C*, bears one branch, *r*, and the second, *a*, another branch, *i*, which at last becomes the continuation of the stem; in the first the twin scales *f* and *g*, in the second the leaf *C*, stand opposite to the supporting organs. Thus all the foliaceous organs would be distichous, but the branches *r* and *i* would not harmonize, *r* being left without a leaf *C*. The principal objection, however, to this explanation is the unmistakable continuation of the structure in what I have considered the stem, while in the peduncle it is reversed just as it is in the branch.

USE. — The tubers and the seeds of *Nelumbium* are edible and highly nutritive, both being replete with amylum; but they have been eaten only by the aborigines.[1] The boiled seeds closely resemble chestnuts in taste. Some of the largest tubers, obtained about the end of September, I had cooked; they were not done as soon as potatoes, and retained much more firmness; baked, they were much more palatable than boiled, and had a pleasant, sweet, and mealy taste, considerably resembling that of sweet potatoes, without anything reminding one of their growth in stagnant water. The decomposing tubers become gray, and at last black, the inside assuming a beautiful purple color, and a very fetid odor, somewhat resembling that of rotten potatoes. The purple color is produced by deep purple globules forming in the cells, one in each, and considerably larger than the starch granules; undoubtedly some rudimentary fungoid production.

FROM PARRY'S PHYSIOGRAPHY OF THE ROCKY MOUNTAINS, APPENDIX (TRANS. ST. LOUIS ACAD. OF SCIENCE, PROCEEDINGS, VOL. II. 1865).

NUPHAR POLYSEPALUM, *n. sp.*: foliis late ovatis sinu angusto profunde cordatis; floris magni sepalis 9–12 concavis mediis maximis, petalis 12–18 spatulatis retusis, staminum numerosissimorum antheris apice truncato- [283] appendiculatis filamenta demum recurva æquantibus seu eis brevioribus, ovarii urceolati striati radiis stigmatosis 13–21 disci umbilicati marginem crenatum fere attingentibus; bacca versus apicem constrictum nec rostratum sulcata.

In small lakes, in the higher Rocky Mountains, from the sources of the Platte, near Long's Peak, lat. 40°, to those of the Columbia River, lat. 44°. Dr. F. V. Hayden collected it in the then Capt. W. F. Raynold's Expedition, on June 20, 1860, in a small lake, between Henry's Fork and Snake Fork of the Columbia River, at an altitude of 6,500 feet. Miss Merrill, in the year 1862, brought from Gibson's Lake, near Long's Peak, some of the large reddish sepals, verifying her vague account of the plant; and, finally, Dr. Parry gathered ample material and full notes, which have been largely used in the following description, in Osborn's Lake, in the same region, at an altitude of 8,800 feet, where it grows with *Menyanthes trifoliata*, *Utricularia intermedia*, *Scirpus*, *Carex*, etc.; he found it in flower in August, the temperature of the water being at the time 58 degrees.

The leaves are more like those of *Nuphar luteum* of Europe than those of our *N. advena*, being oval in outline, not deltoid-orbicular, and with a narrower, more closed sinus, the obtuse lobes more gradually separating from one another. In *N. advena* I find the sinus often of 75 degrees; the lobes are then triangular, with acutish points; but this form of the sinus, and shape of the leaf, is by no means constant, for whenever the substance of the leaf is more fully developed, the lobes become broader, more obtuse, and the sinus, of course, narrower, as I find it in specimens from Arkansas; while sometimes, as in specimens from Houston, Texas, the sinus becomes closed up, and the lobes even overlap.

The leaves of our species were floating when observed; five of them were $8\frac{1}{2}$–$9\frac{1}{2}$ inches long and $6\frac{1}{2}$–$7\frac{1}{2}$ inches wide; these five leaves, and five of *N. luteum*, give each an average proportion of length to width as 10 to 8, while the same number of leaves of *N. advena*, from different parts of the United States, gives the proportion of 10 to 9. The difference seems small enough, but in the appearance of the leaf is quite striking. I notice, also, a difference in the venation of the leaves of these three species, there being, in our species, nearly three times as many veins connected with the midrib as issue from the base, while in both the other species I observe only about twice as many

[1] The Chariton River in Missouri, after which Chariton County is named, is said to derive its name from the Indian word for *Nelumbium*, a plant very abundant there and highly esteemed by the Indians.

from the midrib as from the base. It may, in this connection, not be out of place to state that, as far as my observations extend, all the species of *Nuphar* can be readily distinguished from all those of *Nymphæa* by their venation, the former having by far the largest number of secondary ribs connected with the midrib, while in [284] *Nymphæa* most ribs are basilar, and few only come from the midrib.

The flowers of our plant emerge a few inches above the surface of the water; they are the largest of any known *Nuphar*, and are composed of from 9 to 12 sepals, many more than we find in any other species, whence the name. The sepals being concave, and "the inner ones curved in, partially concealing the greater part of the dense mass of stamens," the flower becomes "globular cup-shaped," and is about 3 inches in diameter, while, when fully laid open, it measures 4½–5 inches. The sepals are arranged, not, as it was at first supposed, in 3 or 4 whorls of 3 sepals each, but in $\frac{5}{13}$ disposition, or, perhaps, the outer ones in $\frac{2}{5}$ divergence, gradually changing into $\frac{5}{13}$. The sepals increase in size and petaloid appearance from the outermost or first to the 7th or 8th, when they decrease again in size, but become of more delicate petaloid structure and color; the three outer ones are oval, 1¼–1½ inches long, green with yellowish margins; the 2 or 3 next ones are orbicular, 2–2½ inches long, and of a yellowish green color; the following ones are the largest, 2½ inches long, 3 inches in diameter, transverse in shape, broadly spatulate at base, and retuse or truncate above; they are yellow, and often "tinged with the red of a deep peach blush, especially in fading;" and the innermost are smaller again, spatulate-orbicular, often emarginate, 1–1½ inches long, yellow, or, especially on the edges, reddish brown. Dr. Parry has repeatedly observed transitions between these inner sepals and the petals.

The petals themselves are spatulate, truncate, 12–18 in number, "9 lines long and 6 lines broad;" in the dried specimens I find them only 5 lines long and from 2 to 4 lines wide; in Dr. Parry's specimens they are "deep red in the middle and yellow at the base and tip."

The stamens, much more numerous than in the allied species, together with the anthers and the appendage, are deep red, relieved by the bright yellow color of the (oval, hispid, as in the genus) pollen, the outer ones broader and shorter, the inner ones narrower and longer; at maturity they are recurved.

The stigmatic disc is deeply umbilicate, and bears 13–21 (usually 16–19) stigmatic rays, which extend near to the irregularly crenate margin; it has a green or a deep red color, or red, edged with yellow, and has, in the dried specimens before me, a diameter of 9–11 lines. In *N. luteum* the disc is similarly formed, while in all the western specimens of *N. advena* (I have no others at my disposal) I invariably find the disc entire or undulate, and the rays not extending to the margin.

The fruit found by Dr. Parry, only half ripe, is "smooth, glossy, deep green, and furrowed, especially [285] towards the top;" dry, it is 1¼ inches long, and 1½ inches in diameter.

The flowers of Dr. Parry's plant are more highly colored than that of Dr. Hayden's, and may preserve the name of var. *pictum*, which the discoverer has applied to the species; it seems to bear the same relation to the duller colored northern form that *N. luteum*, var. *rubro-petalum* (Caspary in Schriften der phys. ökon. Gesellsch. zu Königsberg, vol. 2, 1861, tab. 1), does to the common European plant; in that variety the stamens as well as the disc are yellow, like the sepals, only the petals, and especially their upper surface, are "brown blood-red." On page 50, Prof. Caspary alludes to our *N. advena* as being more frequently found with red petals and points of stamens than with yellow ones, a fact which will be new to many of our botanists, as, at least in the Western and Southwestern States, a red tinge has not been observed by them.[1] — July 27, 1865.

II. ON THE DIMORPHISM OF DRABA BRACHYCARPA.

From the Transactions of the Academy of Science of St. Louis, Vol. II. 1862.

This humble white flower is at this season very abundant on the grassy hills about [154] town, associated with *Draba Caroliniana*, the pretty *Houstonia minima*, with *Androsace occidentalis*, *Plantago pusilla*, *Ranunculus fascicularis*, *Myosurus minimus*, and the completely naturalized *Capsella*. In ordinary or in wet springs the flowers are all regularly formed and comparatively large, having a diameter of about 2 lines; in very dry springs, however, such as the present one, a form with very inconspicuous flowers becomes common, which in isolated specimens in the

[1] After this was written, I received from Prof. A. Gray a specimen of *Nuphar advena*, found in Massachusetts, with a brownish-red tinge on the outer, and a red blush on the inner sepals, red-tipped petals and reddish ovary and stigmatic disc; the outer stamens only showed a slight red tinge just *below* the polliniferous part.

herbarium might be taken for a distinct species, but, studied on its native hills in thousands of specimens, clearly proves to be nothing but a depauperate or abortive state and not even a clearly defined variety.

During a late excursion to our commons in company with Dr. Hilgard, he ascertained that on the northern slopes of hills and sinkholes, and near the edge of ponds, the plant had the ordinary appearance, but on the sunny and dry or even arid southern slopes not a single one among the thousands of specimens could be found the flowers of which were not quite inconspicuous; in intermediate situations the size and organization of the flowers were also intermediate.

These incomplete flowers are smaller in all their parts than the regular ones; the sepals are erect and rather persistent; the petals always shorter than the sepals, but variable in size, shape, and number, or even entirely absent; the stamens always abortive and often reduced in number; the ovary shorter but fertile.

The petals (ordinarily broadly obovate-spatulate, retuse, over 1 line long) are here linear-spatulate, entire, emarginate or bilobed, $\frac{1}{8}$-$\frac{1}{3}$ line long, 2 or 4 in a flower, often of unequal size in the same flower, or entirely absent. The slender filaments bear a bilobed cellular head, often not more than 0.05 line long, representing the anther, but without any regular structure. He found in single flowers 4, and often 5 or 6 of them, without petals, or associated with 2 or 4 rudimentary petals. It appears that in some incomplete tetrandrous flowers the pairs of stamens adhere to [155] the base of the corresponding exterior, and the pairs of petals to that of the interior sepals; the 8 organs forming rather one than two cycles.

How these female plants, as they must be called, which, this spring at least, form the immeasurably largest part of the whole crop, can be fertilized by the few complete ones growing in the neighborhood, is not easy to understand.

Does not this dimorphism obtain in other species of this genus, in *Lepedium* and other *Cruciferæ*, and would not several so-called species fall, if correctly understood, under other fully developed ones as incomplete forms? — *Journal of Proceedings*, April 15, 1861.

III. STRUCTURE OF THE FRUIT AND SEED OF RIBES.

From the Transactions of the Academy of Science of St. Louis, Vol. II. 1862.

Dr. Engelmann exhibited several drawings illustrating the structure of the fruit and seed [180] of the genus *Ribes*. His investigation of what constituted the pulp of the Cactus fruit (see p. 166) had induced him to examine the juicy fruits of allied families. It seemed strange that the structure of the gooseberries and currants, so common everywhere, had not, as far as he could ascertain, attracted the attention of vegetable anatomists. The only allusion he found to it was in Schleiden's Grundzüge (ed. 3, p. 408), where it is said that the pulp of the berry of *Ribes* seemed to be formed by the dissolution of the cells which originally constituted the testa itself. Dr. Engelmann found this pulp to consist of the arillus and of the modified epidermis of the testa.

The arillus of *Ribes* is a fleshy or juicy dilatation of the funiculus; in the currants, at least in *R. rubrum*, it is very short, cup-shaped, lobed, often obcordate, and embraces the base of the seed; in the gooseberries (*R. Grossularia* and *R. hirtellum* were examined) it is much larger, as high and sometimes as large as the seed itself, entire, and attached to the funiculus, all along the [181] rhaphe. The substance of this arillus is rather firm, and consists of very small cells, in the common gooseberry between 0.01 and 0.05 line in diameter. The arilli of different seeds are apt to coalesce.

The epidermis appears as a seemingly gelatinous transparent coating of the seed. It consists of simple, prismatic, 5- or mostly 6-angled, connate cells, each, in the different species examined, 0.06–0.10 line in diameter, and 0.3–0.5 line high, near the rhaphe much shorter. The contents of the cells are very pale red or colorless, the green or buff color of the seed appertaining to the testa itself. In some cultivated varieties these cells may finally become detached, forming a true pulp; but in the fruits examined by him such was not the case. If that part of the funiculus which forms the rhaphe at last becomes detached from the seed, as has been stated, it must be after a separation of these epidermis cells.

Dr. Engelmann noticed that the inner coating of the carpellary cavity of *R. rubrum* consisted of a singular deposit of crustaceous and brittle, striated cells or cell-walls, which he had not observed in any other species examined by him. —*Journal of Proceedings*, June 2, 1862.

IV. REVISION OF THE ŒNOTHERÆ OF THE SUBSECTION ONAGRA.

From Gray's Enumeration of Plants of Dr. Parry's Collection in the Rocky Mountains, Supplement 2 (Amer. Journ. Sci. and Arts, Second Series, Vol. XXXIV. Nov. 1862).

A large suite of specimens enables me to clear up some difficulties which have environed the following [333] species of *Œnothera*.

1. Œnothera coronopifolia, *Torr. & Gr. Fl.* 1, *p.* 245; *Gray, Pl. Fendl. p.* 43: perennis, sæpe multicaulis, humilis, erecta seu erecto-patula, puberulo-canescens, strigosa seu hispida; foliis infimis lineari-spathulatis, cæteris pectinato-pinnatifidis; *tubo calycis ad faucem dense villoso; petalis suborbiculatis integris* stamina æquantibus pistillo brevioribus; capsula ovato- seu lineari-oblonga *torulosa basi nunc in pedicellem brevissimum attenuata suberecta; seminibus magnis ovatis turgidis subobtusis varie oblique truncatis tuberculatis.* My specimens were collected by Mr. Fendler (No. 222) near Santa Fé, along water-ducts, and by Dr. Hayden on the sandhills of the Loupfork, on "Running Water." Stems ½–1 foot high: flower white, turning deep red, about an inch in diameter: capsule in Fendler's specimens about an inch long, in Hayden's only about 4 lines long, thicker than in the allied species: seeds yellowish-brown, about a line long, thick, beset with tubercles arranged in longitudinal rows.

2. Œnothera pinnatifida, *Nutt., Gen.* 1, *p.* 245; *Torr. & Gr. Fl.* 1, *p.* 494. *Œ. albicaulis*, Pursh, Fl. 2, p. 733: DC. Prodr. 3, p. 51, non Nutt. *Œ. Purshii*, Don. Syst. 2, p. 688. *Œ. Purshiana*, Steud. Nom. 2, p. 207: annua seu biennis, humilis, diffusa (rarissime erecta), puberula, rarius sursum hirsuta; foliis imis obovato-spatulatis acutis seu obtusis integris, cæteris pinnatifidis sæpe ciliatis; *tubo calycis ad faucem nudo; petalis late obcordatis seu profunde emarginatis genitalia superantibus;* capsula lanceolato-lineari *torulosa sessili suberecta; seminibus ovatis turgidis utrumque apiculatis foveolatis seriatim inter costas dispositis eleganter notatis.* Sandy soil on White River, Upper Missouri, *Nuttall, Geyer in Nicollet's Expedition, Dr. Hayden;* Las Vegas and Santa Fé, New Mexico, *Dr. Wislizenus, Mr. Fendler;* the latter's specimens, few in number, bearing his private number 239, were distributed with others of the next species under No. 223; Southern New Mexico, *Wright* (referred to *Œ. coronopifolia* in Pl. [334] Wright. 1, p. 69.) All the specimens I have seen are either annual (sometimes simple and one-flowered) or, usually, biennial, with rosulate entire radical leaves; branching from the base, diffuse or even decumbent; an erect form was collected by A. Gordon on the Upper Canadian River, No. 29, similar to the last species in habit. Stems usually 4–6 inches high, but, according to Nuttall, the decumbent branches sometimes 2 feet long. Flowers 2½–3 inches in diameter, white, turning pale red: capsule 1–1¾ inches long: seeds very regularly and prettily pitted between the longitudinal ribs, 0.6–0.7 of a line long, yellow. Don and Steudel have changed Nuttall's earlier name, but his must stand, and Humboldt's plant, described five years later under the same name, may receive the name of *Œ. Humboldtii.*

3. Œnothera albicaulis, *Nuttall in Fras. Cat.*, 1813, *& Gen.* 1, *p.* 245; *Torr. & Gr. Fl.* 1, 495; *Gray, Pl. Wright.* 1, *p.* 69, *&* 2, *p.* 56: perennis, glabra, puberula seu hirsuta; caulis *cortice albida membranaceo nitente;* foliis maxime variis; *petalis orbiculato-ovatis* in unguem plus minus attenuatis *integris* stamina superantibus pistillum æquantibus; *capsula e basi crassiore sessili lineari divaricata sæpe flexuosa seu deflexa; seminibus minoribus lineari-lanceolatis lævibus.* A common plant on the western plains, extending into Oregon, New Mexico, and Chihuahua, as variable in habit, growth, and foliage as it is common, but always easily recognized by the unvarying characters of the

flower and fruit as above indicated, and also by its white glistening stems and branches, the epidermis of which is apt to peel off in the manner of many Loasaceæ. The white flowers, 1½–1¾ inches in diameter, at last turn pale-red; the very slender capsule, connected by a very thick base with the stem, is usually 1½–1¾ inches long, and spreads at right angles, or is curved or twisted in various directions. Seeds smooth, dark-brown, lance-linear and usually very acute at one end, and 0.8 line long; var. δ. has smaller (0.6 line) and obtuse seeds. According to foliage and pubescence I arrange the specimens before me under the following varieties: —

a. Foliis basi in petiolum brevem attenuatis.

Var. *α.* NUTTALLII: erecta glabriuscula seu puberula, simplex seu ramosa; foliis linearibus seu lanceolatis seu oblongis integris vel plus minus dentatis. Here belongs *Œ. pallida*, Dougl., with its variety *leptophylla*, Torr. & Gr., as already indicated by Prof. Gray. Nuttall describes this form as sometimes 3 feet high, and Geyer notes that in the sandy plains of Devil's Lake and at the sources of St. Peter's River it forms shrubby bushes of the size of Spartium scoparium, growing even 4 feet high; but it seems more usually between one and two feet high. Leaves 1–2½ inches long and 1–6 lines wide. One of the broadest leaved forms is Fendler's N. Mex. No. 224.

Var. *β.* RUNCINATA: branchiato-ramosa, patula, glabra, puberula seu canescens; foliis lanceolatis grosse seu sinuato-dentatis. This is *Œ. pinnatifida*, Gray, Pl. Fendl. p. 43 (description and most of the specimens No. 223, all those with the private number 243). Fendler gathered it near Santa Fé; Fremont in his 3d Expedition collected a glabrous (No. 222) and a very canescent (No. 178) form, the latter with singularly short but apparently fertile capsules, scarcely 3 lines long.

b. Foliis basi lata truncata sessilibus. [335]

Var. *γ.* BREVIFOLIA: tota glaberrima, erecta, ramosissima; foliis late ovatis abbreviatis grosse dentatis. Sandhills south of El Paso, *Dr. Wislizenus*, No. 99. Leaves dark green, while all the other forms are pale or grayish, 4–6 lines long, acutish, or often rounded at the end.

Var. *δ.* TRICHOCALYX: erecta, parce ramosa, canescenti-hirsuta; foliis lanceolatis seu lanceolato-oblongis sinuato-dentatis. Las Vegas, New Mexico, *Dr. Wislizenus*, No. 473. — This is no doubt Nuttall's *Œ. trichocalyx*, Torr. & Gr. Fl. l. c., the specific identity of which with *Œ. albicaulis* Prof. Gray has already indicated. The long hair on the stem, ovary, and especially the calyx, consists of a single cell, remarkably broad at base, tapering to an acute point; — it is however the form of hair I find in all long-haired *Œnotheræ*.

V. REMARKS ON VIBURNUM AND CORNUS.

FROM THE TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS, VOL. II. 1866.

DR. ENGELMANN made some remarks about the fruit and seed of different species of *Viburnum*. Unfortunately botanists too frequently neglect to gather the ripe fruit, and the herbaria that he consulted furnished but scanty material for the interesting investigations he had instituted, and which he intended to prosecute. The fruit, he stated, was described as an oval drupe or berry, red, dark blue, or black, with a juicy and edible pulp, and a crustaceous stone containing the minute embryo in a fleshy albumen. He found the berries of different sizes, and generally more or less compressed, but, on the whole, offering no useful diagnostic characters, as might be expected of such a pulpy fruit. The pulp contains, as is well known, saccharine matter (especially in our common "black haw," *Viburnum prunifolium*), or it is more or less acidulous (e. g. in the "tree-cranberry, *V. Opulus*); but he had found as a remarkable exception one species, the rare *V. scabrellum*, specimens of which, collected in Mississippi by Prof. E. Hilgard, were examined, with a pulp as oily as that of any *Nyssa*, or of *Olea* itself. [269]

The most important diagnostic characters are found in the stone and the albumen. The stone is either flattened or it is thick, even, or marked with longitudinal grooves and ridges; the albumen is described as fleshy, but he would rather call it horny, and it contains some oil; it is even and uniform, principally in the flat-seeded species, or more or less folded, or (as it is termed) ruminated, especially in the thick-seeded species.

In the following table are enumerated all the species the fruits of which he could examine: —

VIBURNUM.

A. Stone flattened, oval, or orbicular; albumen even.

a. Stone without distinct markings.

1. *V. prunifolium*, St. Louis and Texas . . . . . 10 mm. long, 8½ mm. wide.
2. *V. Lentago*, Pennsylvania . . . . . 10–11 " " 8 " "
3. *V. obovatum*, Georgia . . . . . 6½–8 " " 4½–6 " "
4. *V. nudum*, New Hampshire and Mississippi . . . . . 5½–6 " " 4½–5 " "
5. *V. Opulus*, Germany, Illinois . . . . . 7–8½ " " 5–7½ " "
   Var. *edule*, Wisconsin . . . . . 6½–7½ " " 7½–8 " "

b. Stone with 3 more or less distinct grooves on flat or ventral, and 2 on convex or dorsal surface.

6. *V. pauciflorum*, Rocky Mountains . . . . . 5½ mm. long, 5 mm. wide.
7. *V. acerifolium*, Wisconsin, New Hampshire, Georgia . . . . . 6½–7 " " 5½–6½ " "
8. *V. pubescens*, Wisconsin, Louisiana . . . . . 6–7 " " 5½ " "
9. *V. dentatum*, Wisconsin, unripe . . . . . 8 " " 4½ " "

B. Stone thick, much longer than wide. [270]

a. Stone somewhat compressed; albumen not (in 10) or slightly (in 11) ruminated.

10. *V. scabrellum*, Mississippi, with one wide ventral groove . . . . . 7 mm. long, 4½ mm. wide.
11. *V. lantanoides*, Massachusetts, with six distinct grooves . . . . . 7 " " 5 " "

b. Stone oval or subglobose, not compressed.

α. Stone with a narrow and deep ventral groove; albumen deeply excavated, slightly ruminated.

12. *V. microcarpum*, Mexico . . . . . 4 mm. long, 3½ mm. wide.
13. *V. odoratissimum*, India . . . . . 8–9 " " 5½ " "

β. Stone with very slight grooves, albumen oval, not excavated, very deeply ruminated.

14. *V. Tinus*, Southern Europe . . . . . 6½–8 mm. long, 5–5½ " "
15. *V. rugosum*, Canary Islands . . . . . 8–9 " " 5–6 " "

The stones of *V. prunifolium* and *Lentago* he was unable to distinguish, and he almost felt inclined to unite both, as, in our neighborhood at least, the former was a most variable plant, with broad or narrow, obtuse, acute or acuminate, glabrous or rusty leaves, and larger or smaller flowers, growing in rocky woods or in deep bottoms, and with many approaches to the eastern *V. Lentago*, which, in its typical form, was not found here.

In *V. nudum* and still more in *V. obovatum*, the markings so characteristic of *V. acerifolium* are already present, though not very distinct.

The stones of the European and the American *V. Opulus* which he could examine were all broadly oval and longer than wide; but a few specimens of what was labelled *V. edule* had stones broader than long, and deeply emarginate at base; further investigation must show whether this is a constant character, perhaps with others sufficient to re-establish that species of Pursh. The only fruit of *V. dentatum* he could examine was unripe, and the stone was no doubt narrower than it would be in the ripe berry.

Among the fruits of *Viburna*, mostly from the East Indies, obligingly communicated by Prof. A. Gray, he found those of *V. punctatum* similar to *V. nudum*, though larger; *V. erosum* of Japan, with a lenticular irregularly marked stone, might also belong here; *V. orientale*, of the Caucasus, was the representative of our *V. acerifolium*; the red-fruited *V. cotinifolium*, *premnaceum*, *stellulatum*, and perhaps *Colebrookianum*, had stones similar to our black-fruited *dentatum* and *pubescens*, though narrower. The stones of *V. plicatum*, of Japan, *V. Simonsii*, *erubescens*, and also of *grandiflorum*, were like those of our *V. scabrellum*.

For those species of *Viburnum* he had more fully examined he would suggest the following arrangement, in which he had been obliged to overlook the presence or absence of a radiated inflorescence, which heretofore constituted the principal character of the sections of this genus: —

1. *Opulus* would comprise species 5–7, with lobed leaves, radiated or uniform cymes, red or black-red berries, and flat, smooth or marked stones.

2. *Lentago* with species 1–4; leaves serrulate or sometimes entire, glabrous or squamulate, cymes even, berries bluish-black, stones flat, not or scarcely marked.

3. *Lantana* with species 8–11; leaves finely or coarsely dentate, glabrous or often with stellate pubescence, cymes even or, rarely, radiate, berries bluish-black, stones strongly marked, compressed or tumid. This section might be subdivided according to the form of the stones above described.

4. *Tinus* with species 12–15; leaves perennial (always?), entire or minutely sinuate- [271] toothed, cymes even, berries purple or black, often shining, stones tumid with ruminated albumen.

In explanation of the measurements given in the above table he would add, that he had, in conformity with the usage now almost universal among men of science, adopted the French decimal measure, and hoped it would supersede, even in common life, the inconvenient measure of feet, inches, and lines. For those not familiar with it, it will suffice to state that the millimetre is about equal to half a line.

Dr. Engelmann had observed similar, though not as strongly marked differences in the fruits and stones of the different species of *Cornus*. Thus, the stone of our common *C. asperifolia* (a small tree with us) is subglobose, small, nearly smooth, marked with very slight furrows; the eastern *C. circinata* has larger stones, marked by indistinct undulations; the low, shrubby *C. sericea* of our swamps bears a stone twice as large, and quite knotty, with thick ridges; our Dogwood, *C. florida*, has a larger and elongated stone, acute at both ends, and slightly grooved; the stone of the nearly allied Californian *Cornus Nuttallii* is still larger, obtuse at both ends, and scarcely grooved, and that of the northern *C. Canadensis* is from a rounded base elongated to a pointed tip, and is perfectly smooth. He solicited botanists to furnish him with ripe fruit of any species of *Viburnum* and *Cornus* within their reach, so as to enable him to prosecute these investigations.

VI. PAPERS ON GENTIANEÆ.

NEW SPECIES OF GENTIANA, FROM THE ALPINE REGIONS OF THE ROCKY MOUNTAINS.

From the Transactions of the St. Louis Academy of Science, Vol. II. 1862 (Distributed May 5, 1863).

Gentiana (Amarella) acuta, *Michx.*, var. nana.: pusilla, subsimplex; calycis 4–5-fidi lobis inæqualibus tubum corollæ cœruleo-virescentis æquantibus; laciniis corollæ fauce ciliis paucis ornatæ ovatis obtusis. [214]

On alpine slopes, together with *G. prostrata* in mats of *Silene acaulis; Parry*, No. 309. — Stems 1½–2 inches high, flowers 4–5 lines long; distinguished from the ordinary form by the short and broad lobes of the corolla, which bear a few (1–4) single cilia at their base, and by the short oval anthers.

G. acuta is evidently but a form, a geographical variety of *G. Amarella*, as Dr. Hooker has indicated, and which is confirmed by our dwarf variety and other forms collected in Colorado by Messrs. Hall & Harbour (No. 473); the characters of acutish lobes of the corolla and small seeds do not hold good; Dr. Parry's No. 307 has seeds as large as *G. Amarella* from Prussia, and several forms have quite obtuse lobes. I have even some doubts about [215] the specific difference of *G. tenuis*, which is characterized by smaller flowers, short, obtuse or retuse lobes of the corolla with sparing fringes, and (in my specimens) very indistinct glands at the base: specimens of *G. acuta*, with strictly erect branches, smaller, greenish flowers, and small seeds, seem to approach it almost too closely.

Pl. 9, Fig. 6, represents two specimens of our plant; 7, a flower; 8, corolla laid open; 9, pistil. Fig. 7–9, 4 times magnified.

Gentiana (Amarella) heterosepala, *n. sp.*: annua, humilis, erecta, simplex, pauciflora, glabra; foliis infimis obovato-spatulatis, superioribus ovatis basi lata sessilibus obtusis seu subacutis margine (sub lente) scabrellis; floribus singulis breviter pedunculatis; calycis 5-fidi lobis 2 maximis ovatis acutis corollam fere æquantibus, reliquis 3 brevioribus lineari-subulatis; corollæ basi indistincte glanduliferæ fauce ciliis paucis barbatæ laciniis lineari-oblongis obtusis tubum dimidium æquantibus patulis; antheris ovato cordatis; pistillo lineari.

Northern slope of the Uintah Mountains, east of the Great Salt Lake; beginning to flower at the end of August; *H. Engelmann*, in Capt. Simpson's Exped., 1859. — A very slender plant, 2–4 inches high, usually with 4 pairs of leaves of a delicate pale green color, the larger ones 6–10 lines long, 4–5 lines wide; flowers 6 lines long, pale grayish-blue; ciliæ of throat few, in two fascicles at the base of each lobe. Remarkable for the great disparity of the calyx

lobes; in that respect near *G. campestris*, but very different otherwise, and, like *G. tenuis*, a connecting link between Grisebach's Amarellæ and Arctophilæ. — Pl. VIII., Fig. 1. One of the largest specimens ; 2, a single flower; 3, calyx, spread out ; 4, corolla, laid open ; 5, pistil. Fig. 2–5, 4 times magnified.

Plate VII. — Gentiana Wislizeni.

Gentiana (Arctophila) Wislizeni, *n. sp.:* annua, erecta, ramosa, glabra ; foliis (sub lente) margine scabrellis, imis spatulatis obtusis, superioribus e basi latiore sessili lanceolatis 3–5-nerviis obtusiusculis, summis acutis ; cyma contracta thyrsiformi; calycis membranacei truncati lateraliter fissi spathacei lobis herbaceis linearibus tubo suo multo brevioribus corollæ tubum dimidium fere attingentibus ; corollæ laciniis ovato-lanceolatis acutiusculis tubo angusto sensim dilatato basi glandulifero bis brevioribus basi breviter barbatis vel nudiusculis ; ovario capsulaque lineari-lanceolata subsessili.

Mountains of Llanos in the State of Chihuahua, 7,000–8,000 feet high, in pine woods; flowers in October ; *Dr. A. Wislizenus*, 1846. — Stems 10–12 inches high, strictly erect ; leaves 1–1¼ inches long, 3–4 lines wide at base ; calyx 2 lines long, slit to the base ; pale bluish corolla, 5 lines long, with 5 strongly marked glands near the [216] base ; throat naked, or usually with an irregularly dentate or ciliate membrane at the base of each lobe; seeds oval, rounded, 0.2 line long. — Abundantly distinguished by the spathaceous calyx, which is not found in any other allied species, though not rare in the sections Pneumonanthe and Cœlanthe.

Gentiana (Crossopetalum) barbellata, *n. sp.* : e caudice perenni tunicato 1–2-caulis, humilis, glaberrima, uniflora; foliis carnosulis obtusis margine tenuissime cartilagineo-crenulatis, infimis lineari-oblongis in petiolum basi vaginantem attenuatis, caulinis paucis linearibus basi connatis, inferioribus 2 elongatis basi attenuatis, summis 2–4 basi latiore florem subsessilem fere involucrantibus acutis ; calycis 4-fidi lobis triangulato-lanceolatis tubo suo vix longioribus

tubum corollæ longe excedentibus, exterioribus paulo latioribus margine membranaceo sæpius dentatis; corollæ laciniis lineari-oblongis obtusis erecto-patulis margine medio breviter ciliatis versus apicem dentatis tubo profunde campanulato intus ad basim filamentorum ciliato glandulifero fere duplo longioribus; ovario ovato basi attenuato, stigmatibus semiorbiculatis sessilibus; seminibus squamulosis.

PLATE VIII. — GENTIANA HETEROSEPALA.

On the alpine summit of Mount Flora, in the Snowy Range, Colorado, *Dr. Parry;* flowers September. — A perennial, 2–4 inches high; radical leaves 1 inch long and 3–4 lines wide; single pair of cauline leaves on the lower half of the short stem $1\frac{1}{2}$–$1\frac{3}{4}$ inches long, narrowed at base; the 2–4 upper involucral leaves much broader at base; calyx about 1 inch and corollæ $1\frac{3}{4}$ inches long; lobes of corolla deep azure blue, about 1 inch long, 3 lines wide; tube inside greenish yellow, with short purplish-brown filaments; lower part of the filaments attached in the middle, the free edges beset with long and slender fringes; oblong glands between the bases of the filaments very marked; seeds (unripe) very similar to those of the allied *G. crinita,* rough from scales, which properly are desiccated vesicles, protruding epidermis-cells. Our species is in many respects the American representative of the European *G. ciliata;* both are perennials with short peduncles, with ciliated bases of the filaments and short oval ovaries, but the seeds are very different.[1]

GENTIANA (CHONDROPHYLLA) PROSTRATA, var. AMERICANA: foliis erecto-patulis ovatis obtusis mucronulatis seu [217]

[1] The section of *Crossopetalum* may be arranged thus: —

a. Lepidospermeæ.

1. *G. crinita,* Froel.: annua, in pedunculis elongatis multiflora, crossopetala. — Our American *G. detonsa* can be distinguished only by the narrow bases of the leaves; the characters taken from the shape of the ovary are variable; whether the original European *G. detonsa* is distinct, I cannot at present ascertain.

2. *G. lanceolata,* Gris.: perennis ? in pedunculis elongatis pauciflora, leiopetala.

3. *G. barbellata,* Eng.: perennis, in pedunculis subnullis uniflora, crossopetala.

b. Pterospermeæ.

4. *G. ciliata,* Linn.: perennis, in pedunculis brevibus pluriflora, crossopetala.

5. *G. simplex,* Gray: annua, in pedunculo elongato uniflora, leiopetala.

The seeds of the annual *G. ventricosa, G. macrocalyx,* and the perennial *G. macrantha,* all with fringed corolla, are unknown.

muticis ; floribus parvis 4-fidis azureis, calycis corollæque lobis acutis, plicis triangulatis plerumque integris; capsula lineari-oblonga in stipitem brevem attenuata.

On Mount Flora and other alpine peaks of the Snowy Range, Colorado, *Parry*, No. 306 ; *Hall & Harbour*, No. 475 ; Russian Arctic America, *Chamisso* in Herb. Gray. — A very small form, 1–2½ inches high, single or with a few ascending or prostrate branches from the base; flowers always 4-parted (in the European plant, which I have been unable to compare, they are said to be 5-parted), deep azure blue, 5½–6 lines long, scarcely 1 line in diameter; capsule tapering at base, not abruptly rounded; seeds finely striulate, ½ line long.

Pl. IX., Fig. 10, 3 specimens of the smaller form, nat. size: 11, a flower ; 12, corolla, laid open ; 13, pistil ; 14, capsule, — all 4 times magnified ; 15, seeds, 10 times magnified.

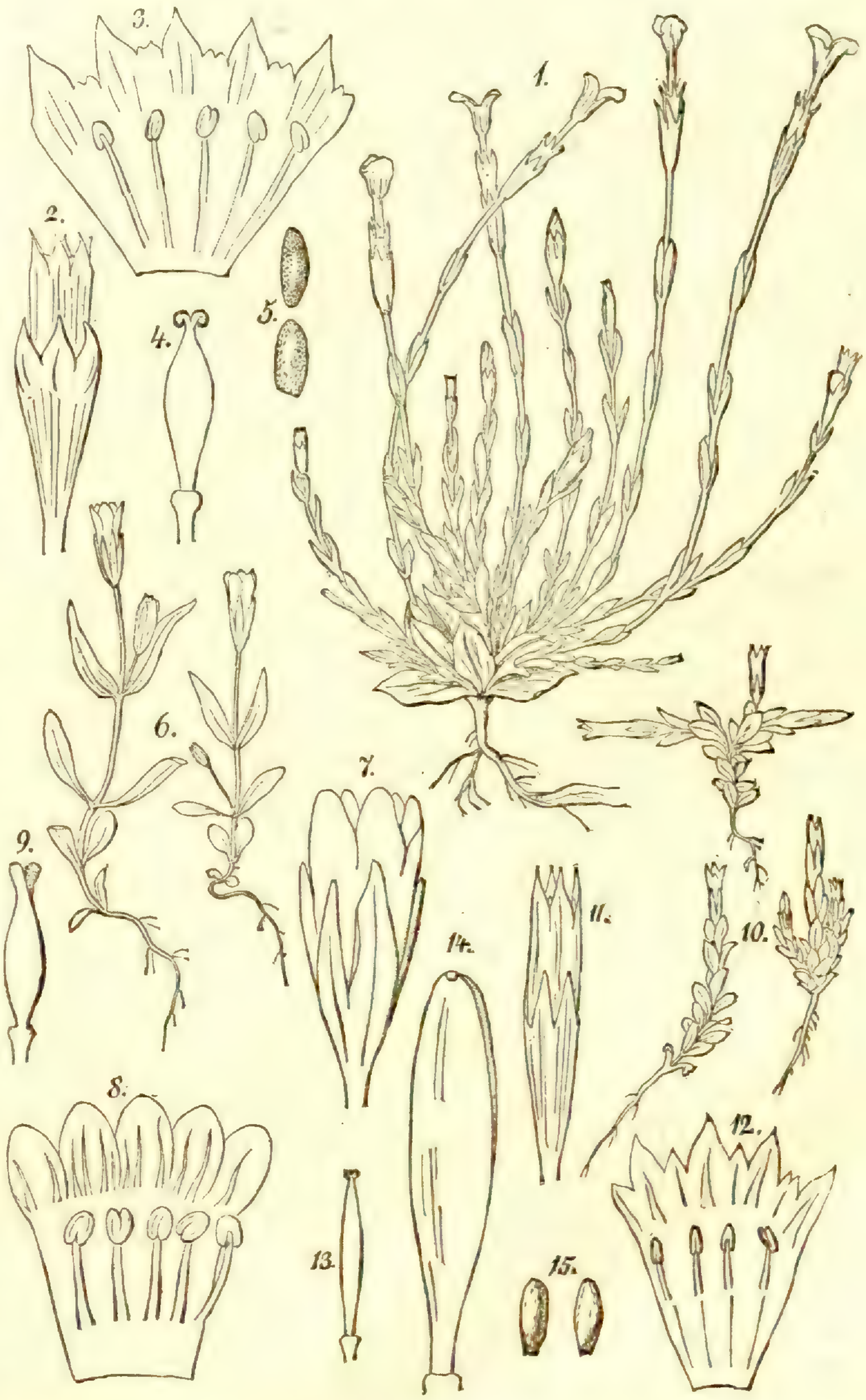


PLATE IX. — 1–5, G. HUMILIS. 6–9, G. ACUTA, VAR. 10–15, G. PROSTRATA, VAR.

GENTIANA (CHONDROPHYLLA) HUMILIS, *Stev. in Act. Mosq.* 3, *p.* 258, *ex Gris. in DC. Prod.* 9, *p.* 106; *G. Fremontii*, Torrey in Frem. 1st Exped., p. 94 ; along moist, grassy banks of Upper Clear Creek, Bear Creek, and other mountain streams, with *Polygonum viviparum*, almost hidden among grass and sedges ; *Parry*, No. 135 ; *Hall & Harbour*, No. 474 ; on the Wind River Mountains, *Fremont ;* flowers June and July. — Many erect or ascending, rarely prostrate, one-flowered, fragile, succulent stems, 1–5 inches high ; pale green leaves, with a broad white margin, cuspidate or mucronate, — lower ones orbicular or ovate, rosulate, — cauline ones linear-oblong, connate at base and sheathing ; flowers on short or longer peduncles, 4–4½ lines long, with spreading rotate limb (Parry), green with bilobed white and transparent folds ; ovary lance-oval on a short stipe, style short with recurved stigmas ; capsule on a stipe of different length, usually raised above the corolla, but sometimes enclosed in it, and then, at last, bursting sideways through the integuments, as appears on the left-hand branch of our figure ; valves of capsule at last widely opening, as the figure shows, and giving the plant a very singular appearance ; seeds irregularly linear-oblong, nearly ½ line long, finely striulate, very similar to those of the last species.

Specimens from the Altai Mountains are absolutely identical with ours with the exception of the folds of [218] the corolla, which in the former have acute and in ours obtuse lobes. Pl. 9, Fig. 1–5.

GENTIANA (PNEUMONANTHE) PARRYI, *n. sp.*: caulibus e radice perenni ascendentibus vel erectis spithameis singulis pluribusve simplicibus foliosis paucifloris; foliis glaucescentibus e basi lata ovato-subrotundis ovatis seu ovato-lanceolatis obtusiusculis seu acutis patulis, summis angustioribus carinatis naviculatis flores sessiles involucrantibus; floribus paucis capitatis magnis purpureo-cyaneis; calycis 5-fidi membranacei integri hinc plus minus spathaceo-fissi lobis linearibus tubo suo brevioribus; corollæ apertæ tubo obconico calycem bis superante, lobis erectis late obovatis brevissime acutiusculis plicas bifidas vix excedentibus; ovario lanceolato basi in stipitem attenuato.

PLATE X. — GENTIANA PARRYI.

Near the base of alpine slopes on the Snowy Range, Colorado, *Parry*, No. 304, the broad-leaved form; *Hall & Harbour*, No. 470, partly a narrow-leaved form; Middle Park, *Parry*, a narrow-leaved, one-flowered variety; a form with narrow leaves has also been collected by Fremont, Creutzfeld, and Howard, as Prof. Gray informs me. Flowers in August. — A very striking species, the large dark purplish blue flowers contrasting beautifully with the broad pale leaves; stem 5–9 inches high, leaves 10–12 or 15 lines long, and from 3 to 10 lines wide, slightly roughened on the edges; flowers 15–18 lines long, enclosed by a pair of boat-shaped bracts; calyx with its short linear lobes half as long as the tube of the corolla, entire or sometimes more or less slit on one side; lobes of the corolla about one-third as long as the tube, wider upwards than at base; slender segments of the folds almost as long as the lobes. — The nearly allied *G. calycosa*, Gris., differs by its single flowers, absence of involucrum, large oval lobes of calyx, and the length and shape of the folds; *G. Menziesii*, Gris., and *G. platypetala*, Gris., both, like the former, northwestern species, have also single flowers, a different calyx, and subcordate lobes of the corolla. The Asiatic *G. septemfida*, Pall., has long folds slit into many bristle-shaped lobes.

Pl. X. represents the broad-leaved form of our species; in the figure on the left side the uppermost leaf is bent down, to show the shape of the calyx and of the bracts; small flower buds with their bracts are seen on the sides.*

* Notes on several of these species are contributed by Engelmann to Gray's Enumeration of Plants of the Rocky Mountains (Amer. Journ. Sci. and Arts, 2d ser. vol. xxxiv.), 256–257, Nos. 304–310. A short memorandum by Dr. Engelmann on Gentianeæ from Colorado, collected by Hall & Harbour, is also appended to a paper by Asa Gray in the Proceedings of the Philadelphia Academy, Mar. 1863, p. 74. — EDS.

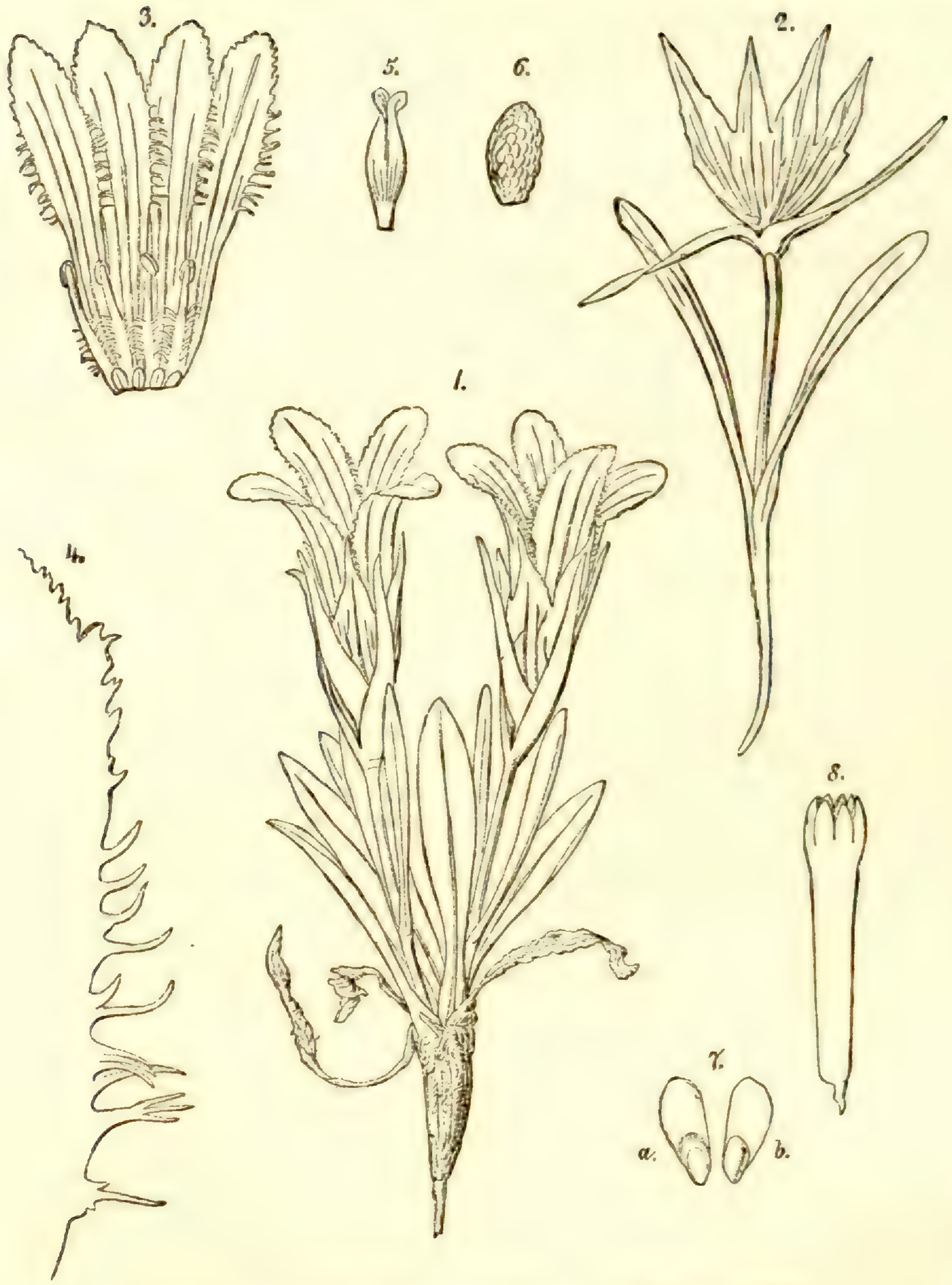


PLATE XI. — 1–6, GENTIANA BARBELLATA. 7, 8, PINUS ARISTATA.

GENTIANEÆ OF WHEELER'S EXPEDITION.

FROM REPORT, ETC. VOL. VI. BOTANY, BY J. T. ROTHROCK, 1878.

ERYTHRÆA CALYCOSA, *Buckley; Gray, Synops.* 113. — Simple or branching from an annual or biennial [189] base; erect stems quadrangular-winged; leaves linear-lanceolate (about 1 inch long), lower ones broader, as long as or longer than the internodes; panicle rather contracted, loose-flowered; pedicels as long as or longer (or the upper ones shorter) than the large flowers (8–10 lines in diameter, rose-colored, with yellow centre); calyx about the length of the flower-tube; lobes of corolla oblong, acutish, often denticulate, scarcely shorter than their tube; seeds small, 0.3–0.4 mm. long.

In the Gila Valley, *Rothrock*, 1874 (325), and southeastward into Mexico, *Gregg*, etc. — Stems 1–1½ feet high, the tallest of our species; leaves 1–1½ inches long, distinguished by its large bi- or tri-colored flowers with acutish lobes. *E. venusta*, Gray, with which it has been confounded, is a smaller plant with larger deeper-colored flowers, broader obtuse corolla-lobes, and usually longer anthers and larger seeds. — The anthers of the different species of *Erythræa* are of different shape and size, from orbicular and oval to oblong and linear and ½–4 or 5 mm. in length; all become at last spirally twisted after they have shed their pollen, the longer more conspicuously so, the shorter much less. The stigmas of this genus have often been misunderstood, probably because mostly observed in dried and pressed specimens. They are never capitate or funnel-shaped, but always bilobed. Before maturity, they remain closed, and only after the anthers have shed their pollen do both halves separate and spread out, just as the Gentians behave. In the form of the stigma I find valuable characters for the grouping of the species, and especially for the distinction of the American ones from those of the Old World. The stigmas of the former are flabelliform and broader than long; those of the latter are orbicular-ovate or oblong to linear; shortest in *E. spicata* and *linearifolia*, and longest in *major*, where they are twice as long as wide, and in *maritima*, in which the length is 3 or 4 times as great as the width. *E. australis* from Australia, as well as *Cicendia* from Europe, have stigmas like [190] the American species, but *E. Chilensis* (at least a specimen collected by Ochsenius in Valdivia, which I refer to that species) differs from all the others in having elongated, cuneate, emarginate stigmas.

The seeds of *Erythræa* are identical with those of a large group of *Gentianeæ*, which comprise perhaps all of Grisebach's *Chironieæ* and *Chloreæ*, being very numerous and very small, from ⅙ to scarcely more than ½ mm. in the longer diameter, and, when fully mature, globose or oval, with their surface favose-reticulate.

The North American genera belonging to this group may be arranged thus: —

1. Stamens inserted in the tube: ERYTHRÆA. EUSTOMA.
2. Stamens inserted in the throat: SABBATIA. MICROCALA. — CHLORA, CHIRONIA, and SEBÆA of the Old World also belong here.

My investigations have convinced me that the genus *Cicendia*, or at least its typical and original species, *C. pusilla*, is nothing but a reduced form of *Erythræa*, distinguished from it only by its small oval anthers, less than 0.5 mm. in length, too short to twist much, but still, when drying, sometimes twisting a little. Its stigma is by no means capitate, but regularly bi-lamellate, and, much like that of the American species, triangular-flabellate, and broader than long. The flowers are 4-parted, which often occurs in genuine species of *Erythræa;* seeds 0.4 mm. long, large for the size of the plant. It will have to bear the name *Erythræa pusilla*.

ERYTHRÆA DOUGLASII, *Gray, Fl. Calif.* 1, 480; *Syn.* 113. — Slender, a span to a foot high, loosely and paniculately branched, usually sparse-flowered; leaves from oblong to linear, acutish; flowers on strict, slender pedicels, 4–5 lines wide; lobes of the pale pink corolla obtuse, much shorter than the tube; anthers usually only 1 mm. long, style short, stigma about 1 mm. wide; seeds subglobose, 0.4 mm. in diameter. — Arizona, Utah, and northwestward to Oregon. This plant has been confounded by Mr. Watson with his *E. Nuttallii*, which, however, is a smaller and more leafy plant, with larger flowers and much larger seeds (0.65 mm. long), but much smaller stigmas.

GENTIANA[1] HUMILIS, *Stev.*; *Griseb. in DC. Prod.* 9, 106; *Engelm. Trans. Acad. St. Louis*, 2, *pl.* 9, *figs.* [191] 1–5; *Gray, Syn.* 120. — Biennial, with large, broadly oval, rosulate, white-margined basal leaves, and few or

[1] The presence or absence of folds or plaits between the lobes of the corolla and the mode of attachment of the anthers to the filament separate the Gentians into two large and very natural sections, already recognized by old authors: *Gentianella*, Borkhausen, Gray, has a corolla without folds and the anthers versatile; *Pneumonanthe*, Necker, Gray, has a corolla with folds between the lobes and fixed anthers. It will not be useless to explain the term *versatile* in respect to anthers, as many seem to misunderstand it, so that they speak of versatile anthers as accidental and unconnected with a physiological process. The fact is that in *Gentianella* the anthers are introrse in the bud and after it first opens; but as soon as the flower is fully expanded (generally toward the middle of the day) the anthers gradually assume a horizontal position (the notched base raised and turned toward the as yet immature and closed stigma), open the cells upward, and begin to shed their pollen. Toward evening, the now effete anther is turned over backward, and on the next morning we find it hanging on the back of the filament, the notched lower end turned up and the empty cells directed outward. Thus in about twelve hours it has described an almost complete circle. In my figures of Gentians in the Transactions of the Academy of St. Louis, vol. 2, pl. 7, 8, 9, and 11, versatile anthers are erroneously represented as turning indiscriminately outward or inward. This is a mistake, as the above account of the living action of the anthers shows. In the figures of *G. humilis* and *prostrata*, pl. 9, the anthers are also figured as versatile in that unnatural manner, while in these species they are constantly erect and introrse, as well before opening as when effete.

In *Pneumonanthe* the anthers remain fixed in two forms. In one section, comprising mostly smaller plants, with smaller flowers (*G. prostrata, verna, Altaica, humilis, utriculosa*, etc.), they are introrse. In another section, the true perennial large-flowered *Pneumonanthes*, to which we must add also an annual, *G. Douglasiana*, and the European *G. cruciata*, they are extrorse. In the genera *Halenia, Pleurogyne, Swertia*, and *Frasera*, all represented by plants collected in these expeditions, we find the same arrangement of versatile anthers as in *Gentianella*. It therefore seems proper to enumerate, first, the Gentians with fixed anthers, and next those with versatile anthers, and then, joining them, the other genera with similar versatile antheral arrangement.

many ascending stems of a pale yellowish-green ; cauline leaves small, linear-oblong ; flowers single, terminal ; *corolla greenish or whitish*, 4–6 lines long, tubular, with acute lobes, and short, notched folds ; anthers oval, introrse ; *capsule clavate-obovate, on a long stipe*, usually much exceeding the corolla ; seeds oblong.

Wet, grassy spots in the higher Rocky Mountains ; also in Asia. The long protruding capsules (trumpet-shaped when open), together with its pale, sickly look, give the little plant a very curious appearance.

GENTIANA PROSTRATA, *Haenke ; Griseb. l. c.* ; *Engelm. l. c. figs.* 9–14 ; *Gray, Syn.* 120. — Annual, small, weak, 1–2 inches high, with horizontal or decumbent branches ; leaves only 2–3 lines long, ovate, green with narrow white margins ; *flowers azure-blue*, 4-parted, terminal on the branches, 5–6 lines long (or in luxuriant specimens sometimes larger) ; lobes ovate-lanceolate ; appendages half as long, similar or sometimes notched ; anthers oval, introrse ; [192] *capsule linear-oblong, short-stipitate*, enclosed in the corolla ; seeds oblong. — Alpine regions of the Rocky Mountains, also in Asia, and rare in Europe, where it is said to have usually 5-parted flowers.

GENTIANA FRIGIDA, *Haenke ; Griseb. l. c.* 111 ; *Gray, Syn.* 120. — Cespitose stems, 1–5 inches high, with fibrous roots ; leaves linear to spatulate, thickish, pale, 1–3 inches long, their bases forming a long sheath ; calyx half as long as the corolla, with subulate lobes and, frequently, a cleft tube ; flowers 1–3, crowded on top, funnel-shaped, $1\frac{1}{2}$ inches long, yellowish or greenish-white, spotted with red and brown ; lobes broad-triangular, acute ; reddish plaits wide, oblique, undulate-crenulate, almost entire ; anthers free ; seeds broad, narrowly winged, with crested ridges.

Springy places, in the alpine regions of the Rocky Mountains, and in Asia ; very rare in Europe. — A very handsome plant in the color of its flowers. Its mode of growth is entirely different from any other of our species. The flowering stems bear in the axils of their lowest leaf-pair, within its long sheath, or breaking through it, leaf-buds which in the succeeding year produce flowering stems, while the base of the old stem withers away. The roots are therefore of only one year's growth, thin and filiform, never thick, as those of most other *Pneumonanthes*, nor is there a real caudex.

GENTIANA PARRYI, *Engelm. Trans. Acad. St. Louis*, 2, 218, *pl.* 10 ; *Gray, Syn.* 121. — Few ascending stems from thick fasciculate roots, about a span high ; leaves glaucescent, thickish, about 1 inch long, broadly ovate to oblong-lanceolate, with a sheathing base, especially in the lower ones ; the uppermost boat-shaped and keeled, involucrating the single or few clustered flowers, concealing the calyx and often almost equal to the large deep-blue corolla ; lobes of calyx linear, short, sometimes almost obliterated, shorter than the campanulate often once- or even twice-cleft tube ; corolla $1\frac{1}{2}$ inches long, somewhat ventricose, its lobes short, broad, acutish, not much exceeding the narrow deeply 2-cleft appendages ; anthers free ; seeds linear-lanceolate, wingless.

Moist grassy places in the alpine and sub-alpine regions of Colorado and Utah.

GENTIANA AFFINIS, *Griseb. l. c.* 114 ; *Gray, Syn.* 122. — Many stems, from a stout rootstock, with thick fasciculate roots, a span to a foot high, mostly ascending ; leaves from oblong to lanceolate or linear ; flowers [193] small for the section, 1–$1\frac{1}{4}$ inches long, usually clustered in the axils of the upper leaves, rarely few ; bracts lance-linear ; calyx-lobes linear, unequal, usually shorter than their sometimes cleft tube ; lobes of the blue corolla acute, plaits bifid, anthers unconnected ; sessile stigmas lanceolate ; seeds narrowly, or sometimes more broadly, winged.

Wet, grassy places in the Rocky Mountains of Colorado and Utah. The numerous thin seeds are borne on the whole inner surface of the capsule, which thus not only has the function of a placenta, but really seems to be nothing but a thin, membranaceous expansion of the placentæ themselves, forming a free sac within the capsule, which originates from the commissures of the carpels, and remains attached to them only, and is at last otherwise entirely unconnected with the walls of the capsule. It is probable that all the *Pneumonanthes* with ovules from the entire inner surface of the capsule have this structure, and that in the others the ordinary arrangement of commissural placentæ prevails.

GENTIANA SERRATA, *Gun. Fl. Norveg.* 10 ; *Gray, Syn.* 117. *G. detonsa*, Rottb. Fries, Gray's Manual, 5th ed., 387. — Low, simple specimens, a few inches high, with single flowers, 1–$1\frac{1}{2}$ inches long. Mount Graham, Arizona (751), at 9,000 feet altitude.

The Norwegian specimens of this plant in my herbarium have much smaller flowers than ours and much smaller seeds. The "scales" which roughen the surface of the seeds prove, when moistened, to be transparent vesicles, single protruding cells of the epidermis. In the Norwegian form these vesicles are small, oblong, or cylindric ; in the American specimens they are much larger and mostly hemispherical ; in the allied *G. crinita* I find them large and oblong.

GENTIANA BARBELLATA, *Engelm. Trans. Acad. St. Louis*, 2, 216, *pl.* 11. — Has thus far been found only in the mountains of Colorado, near the timber-line, and is a very distinct species, which can in no way be confounded with *serrata* or *simplex*. I have already, in the first account of this species, given the diagnostic characters, and have also stated that it is the only perennial one of the section *Crossopetalum* in America, somewhat allied to the Eu- [194] ropean *G. ciliata*, also a perennial species, which used to be claimed as an annual ; *barbellata*, however, has seeds similar to those of *serrata*, though much smaller, while *ciliata* has the winged seeds of *simplex*, and has an indefinite number of leaves. I have since had the opportunity of studying *barbellata* in the mountains of Colorado, and

found that it possesses a creeping, filiform rhizoma, 2–3 inches below the surface, from which at intervals filiform stems arise. These bear, at their thickened upper end, where they reach the surface of the soil, an undeveloped terminal bud of indefinite growth, and lateral annual flowering stems, the scars of which, enveloped by withered leaf-bases, can be traced sometimes for five or six years back. The vegetation of the plant is accomplished in the following manner. Each season the terminal bud develops two pairs of basal leaves; from the axil of one of the outer leaves the single flowering branch originates. Inside of the two leaf-pairs just mentioned, we find a third and a fourth pair undeveloped, about half an inch long, which are to grow into the basal leaves in the following season; and within these the four leaves of the next succeeding season, now only half a line long, are already preformed. The flowering branch, usually 3 or 4 inches high, normally bears one pair of leaves in the middle, and a second involucral pair just below the almost sessile flower; the four sepals are opposite these four leaves, and the four corolla-lobes alternate with the sepals, and so on. In the axil of one of the third pair of basal leaves preparing for next year, usually alternating with, or sometimes opposite to, the present flowering branch, the bud of next year's flowering apparatus is already four lines long; it shows plainly the two pairs of leaves and the calyx, and, in a very rudimentary state, also the corolla. Thus each year's vegetation exhibits at the flowering period (August and September), on the primary axis, two pairs of leaves for the present, two pairs for the next, and two for the third year, a secondary axis with two leaf-pairs and the flower, and another preformed secondary axis with the rudiments of the same organs for the next year. No other Gentian has, as far as I know, such a typical growth, with the regular preformation of all the organs; but we find the same among other plants in other families, a striking example of which is furnished by our *Nelumbium*. The regularity in our Gentian is not as absolute as in *Nelumbium;* for occasionally two flower- [195]
ing branches are found on the same plant, or three pairs of leaves in place of two, or, very rarely, the upper involucral leaves bear one or even two axillary flowers.

Gentiana Wislizeni, *Engelm. l. c. pl.* 7; *Gray, Syn.* 119. — Annual, erect, a foot or less high, with the habit and the many-flowered thyrsoid-paniculate inflorescence of the next; leaves from lanceolate to ovate, 1 inch or less long, with an obtuse or subcordate base; calyx of barely half the length of the tube of the corolla, with very small teeth, its membranaceous tube cleft, and often, in age, dejected; corolla pale purplish, 4–5 lines long, acute lobes fringed above the base; capsule linear; seeds subglobose.

White Mountains of Arizona, *Rothrock* (799), in 1874. This is the only known locality within our flora of this rare plant, which was discovered by Dr. Wislizenus over thirty years ago in the mountains west of Chihuahua.

Gentiana Amarella, *L.*, var. acuta, *Hook. f. Gray, Syn.* 118. *G. acuta,* Michx. — Annual, 2–20 inches high; stems wing-angled, usually much branched; lowest leaves obovate, petiolate, upper ones lanceolate sessile; inflorescence paniculate or strictly thyrsoid, with shorter erect or in some forms with elongated patulous peduncles; calyx deeply 5-cleft; herbaceous lobes lance-linear, somewhat unequal, often as long as the tube of the bluish-purple corolla, the lobes of which are oblong, obtusish, beset at base with copious (or in the diminutive alpine form, few) setæ; sessile capsule linear; seeds subglobose.

Grassy places in the mountains of Colorado and northeastward. The true European *G. Amarella* has usually 4-parted flowers.

Halenia Rothrockii, *Gray, Proc. Amer. Acad.* 11, 84; *Syn.* 127. — Annual, a span or two high, loosely flowered; lower leaves small, spatulate, those of the stem distant, lance-linear, the uppermost closely approaching subverticillate; flowers cymose-subumbellate, on slender peduncles, often in sevens, nearly 6 lines long, bright yellow, ovate, acute lobes a little longer than the campanulate tube, the five spurs curved, horizontal or ascending, half as long as the corolla; stamens from the throat of the tube; anthers versatile; seeds subglobose-ovate.

On Mount Graham, at 9,000 feet altitude; in flower in September, *Rothrock* (733), in 1874. Evidently [196]
allied to three Mexican species which have also umbelliform cymes; the innermost involucral leaves bear single flowers, the outer ones usually two, and a later secondary flower is borne on a shorter peduncle behind a primary one. This is the only Western species yet discovered. Plate XXI. Natural size. 1. Flower, 5 diameters. 2. Mature capsule, cross-section, about 5 diameters. 3. Vertical section through flower, about 10 diameters.

Pleurogyne[2] rotata, *Griseb.*; *Gray, Syn.* 124. *Swertia rotata,* L. — Stems 2–10 inches high, the smallest ones one-flowered, others thyrsoid-branched, many-flowered; leaves lance-linear; sepals linear, acute, as long as the milk-white ($\frac{3}{4}$–1 inch wide) corolla, acute at both ends.

Moist, grassy places in Colorado, sometimes in large patches, and then disappearing again for years. The spreading flowers of this and the next two genera afford the best opportunity of observing the action of the versatile

[2] Pleurogyne, *Eschsch.* — Erect annuals of cold or alpine regions, with opposite leaves, few or numerous whitish flowers in a fastigiately much-branched panicle; corolla rotate, often 4-parted, in our species with a pair of nectariferous pits at the base of the lobes surrounded by a funnel-shaped crest or a fringed scale; stamens versatile; ovary lanceolate, bearing the linear stigmas decurrent down the sides on the sutures; ovules abundant on the broad placentæ on both sides of the sutures; capsule oval, compressed; seeds oblong, smooth.

anthers as they slowly turn from the introrse to the horizontal, and then to the extrorsely reversed position, as explained above. The glands on the base of the corolla-lobes are distinct enough, but the surrounding scale is apparently not, as it is ignored by many botanists; I have seen it variable, longer or shorter, but always present; when fully developed, it forms a complete crested or fringed funnel. The stigma of this plant is most peculiar, formed as it is directly on the commissure of both carpels and representing a broad stigmatic line commencing about $\frac{1}{4}$ line below the non-stigmatose apex, running down the sides to the same distance above the base, so that we have here a two-carpellary ovary with two lateral, but without any apical stigma. This line is beset with elongated stigmatic cells or papillæ about 0.1 mm. long and $\frac{1}{6}$ as wide. At the proper time numerous pollen-grains are found adhering to the stigma, many of them developing their tubes. The seeds I have been able to examine were not fully matured, but such as they are, they appear oval-oblong, not flattened nor margined, but slightly angular and nearly 0.5 mm. in the longer diameter.

SWERTIA[3] PERENNIS, *L.*; *Gray, Syn.* 124. — A span to a foot high; lowest leaves oblong or obovate, 2–4 [197] inches long; upper few and narrow, sessile; flowers 1 inch wide. — Colorado and Utah mountains, in boggy places; also in Europe and Asia.

FRASERA SPECIOSA, *Dougl. in Griseb. Gent.* 329; *Hook. Fl.* 2, 66, *tab.* 153; *Gray, Syn.* 125. — Biennial; stem stout, 2–6 feet high, very leafy; leaves in fours and sixes, nervose, the radical and lower cauline ones linear-oblong, 6–10 inches long, acutish or obtuse, the upper narrower and shorter; flowers numerous, in a long leafy thyrsus; lobes of the greenish-white (rarely bluish) dotted corolla oval-oblong, acutish (6 lines long), bearing a pair of contiguous and densely long-fringed glands about the middle, and a distant transversely inserted and setaceously multifid scale-like crown near the base; anthers versatile; capsule compressed contrary to the deep boat-shaped valves; oblong seeds flat, margined. — Willow Spring, Arizona, *Rothrock* (251), in 1874; Colorado, *Wolf* (790), in 1873. A mountain species, found in the Rocky Mountains and westward to California and Oregon.

GENIOSTEMON, *Engelm. & Gray,* is characterized by Gray in Contributions to North American Botany (Proceedings of the American Academy of Arts and Sciences, vol. xvi. n. ser. vol. viii. 1880, p. 104). — EDS.

VII. COLLECTED SPECIES OF ASCLEPIADEÆ.

FROM ENGELMANN AND GRAY'S PLANTÆ LINDHEIMERIANÆ, PART I. (BOSTON JOURN. NAT. HIST. VOL. V. 1850).

272. ASCLEPIAS (OTARIA) LINDHEIMERI, *Engelm. & Gray* [42]. 273. GONOLOBUS CYNANCHOIDES, *Engelm. & Gray* [43–44].

FROM THE REPORT ON THE MEXICAN BOUNDARY, VOL. II., BOTANY, 1859.

ROULINIA UNIFARIA, *Engelm. mss.* (*Gonolobus unifarius*, Scheele) [160].

ACERATES AURICULATA, *Engelm. mss.*: caule erecto glabro; foliis sparsis linearibus filiformibus; umbellis [160] pluribus axillaribus multiflorus breviter pedunculatis; pedicellis pilosis calyce extus viloso; corollæ laciniis reflexis; cucullis gynostegio globoso sessili brevioribus apice leviter tridentatis margine involutis basi latissime biauriculatis; folliculis lanceolatis longe rostratis brevibus. Dry ravines near the Copper Mines, and along the Mimbres, June and July; *Bigelow.*

SARCOSTEMMA HETEROPHYLLUM, *Engelm. mss.*; TORR. in Pacif. Railroad Rep. V. p. 362 [161]. ASCLEPIAS INVOLUCRATA, *Engelm. mss.* [163]. ASCLEPIAS BRACHYSTEPHANA, *Engelm. mss.* [163].

FROM PARRY'S BOTANICAL OBSERVATIONS IN SOUTHERN UTAH (AMERICAN NATURALIST, VOL. IX. 1875).

207. ASCLEPIAS LEUCOPHYLLA, *n. sp.* Erect, tall; leaves (upper) sessile with a broad cordate base, [348] tapering to a sharp bristly point, white tomentose; umbels many-flowered, alternating, lateral and terminal; pedicels a little shorter than the peduncles; calyx tomentose; corolla woolly outside; hoods as long as the short-stalked stamineal tube, slightly spreading, ovate, obtuse, rounded on the inner margin; horn from the lower part of

[3] SWERTIA, *L.* — Single-stemmed perennials; leaves occasionally alternate, the lowest ones tapering into an elongated, margined petiole; inflorescence thyrsoid; flowers blue; corolla rotate, with a very short tube; nectariferous pits at the base of its lobes crested with a fringe; anthers versatile; seeds flat, winged.

the hood, broad ascending, horizontally incurved over the cusps of the anthers; pollen-masses lance-linear, slender, slightly curved.

Dry sandy "washes" of the Virgen River, flowers in June, fruit not seen. Stem 3–5 feet high; upper leaves 3½–4 inches long, 1¼–1½ wide near the base, gradually enlarging downwards, white tomentose on both sides, becoming mottled when old. Peduncles about 1 inch, pedicels ¾ inch in length; flowers about the size of those of *A. Cornuti*, with yellowish green corolla and yellow crown. This species is closely related to two other white-woolly south-western species, viz.: *A. vestita*, H. & A., and *A. eriocarpa*, Benth.; the former of which has also long-acuminate [349] leaves, but those of the latter are oblong and obtuse at both ends; all these have a short-stalked crown, broad ovate truncate or rounded hoods, and a short broad horn.

In *A. leucophylla* the hoods are largest and fully as long as the anther-tube, rounded and not dentate at the upper inner edge; the broad falcate horizontally incurved horns originate from the base and lower half of the hood; cartilaginous margin of anthers long, obtuse-angled at base; pollen-masses slender, ¾ line or more long; pistils glabrous.

In *A. eriocarpa* (Hartweg's original specimen in herb. A. Gray, Remy in Mus. Paris) the hoods are shorter than the tube, angular or forming a tooth where the upper and inner margins meet, with two distinct saccate lateral projections; the broad, falcate, horizontally incurved horns originate from the entire midrib of the hood or its upper half; cartilaginous margins of the anthers shorter, sharp-angled below; pollen masses and pistils as in the last.

In *A. vestita* (Douglas' original and Bolander's specimens in herb. A. Gray) the short hood reaches to the top of the anther-tube and has a long horizontal tooth where the upper and inner margins meet; the broad obtuse horn, incurved but more erect and exsert than in either of the allied species, originates from the middle and lower part of the tube; cartilaginous margin of anthers short, rounded below; pollen-masses only ½ line in length, broad in proportion and more curved; pistil hairy.

209. ASTEPHANUS UTAHENSIS, *n. sp.* Glabrous, slender, spreading stems from a thick cylindric root; [349] linear or filiform leaves; axillary few-flowered umbels; dull yellow minute flowers; corolla deeply campanulate with sub-erect cucullate lobes with inflexed points; follicles slender, long-acuminate, smooth; seeds scaly. Drifting sandhills near St. George, the fleshy roots penetrating to a great depth, giving origin just below the surface to the slender branches, that twine on adjoining shrubs or swing loosely on the scorching dry sands. Flowers in May; fruit in June.

This very peculiar little Asclepiad has its nearest relatives at the Cape of Good Hope, with one or two stray species in the West Indies and South America. The whole plant is of a grayish green color, the thick cylindric root light brown; the branching stems from less than a span to over a foot in length; leaves about one inch long, ¼ line wide; flowers about 1–1½ lines wide. The corolla is almost closed by the cucullate inflexed points of the lobes, and is glandular papillose internally, so that here these lobes themselves assume the shape and perform the functions of the hoods of other Asclepiads, to allure and retain insects to assist in the fertilization of the pistil. The pendulous broadly oval pollen-masses are only one tenth of one line long; slender follicles 2–2½ inches long; comose seeds usually rough by scale-like protuberances.*

VIII. PAPERS ON LORANTHACEÆ.

FROM GRAY'S PLANTÆ FENDLERIANÆ (MEMOIRS AMER. ACADEMY, N. S., VOL. IV. 1849).

281. PHORADENDRON JUNIPERINUM, *Engelm. mss.*: glabrum, caule articulato divaricatim ramosissimo [58] ramisque teretibus; ramulis compressis; foliis squamæformibus connatis truncatis vix cuspidatis pelviformibus breve ciliatis; spicis fœmineis lateralibus oppositis abbreviatis bifloris; floribus bractea inferiore majore et duabus lateralibus in cupulam connatis ciliatis fultis globosis 3-(rarissime 4-)lobis. — "Parasitic on the two kinds of Shrub Cedar (Juniperus) which grow on the hills and elevated plains about Santa Fé, and on no other tree; sometimes forming clusters of more than a foot in diameter and three-fourths of a foot in height. Wherever they are found,

* Dr. Engelmann also contributed the article on Asclepiadeæ to Rothrock's Botany of Wheeler's Expedition, 1878, 187–189; but it contains no new species. Descriptions are given of *Philibertia cynanchoides*, Gray, *P. linearis*, var. *heterophylla*, Gray, *Asclepias involucrata*, Engelm., and *A. verticillata*, var. *subverticillata*, Gray.

A. EUPHORBIÆFOLIA, *Engelm. in herb.*, is described by Gray in Contributions to North American Botany (Proceedings of the American Academy of Arts and Sciences, vol. xvi. 1880, p. 104). A. SULLIVANTII, *Engelm.*, is described in Gray's Manual, first edition, p. 366.

GONOLOBUS RETICULATUS, *Engelm. mss.*, is described by Gray (Proceedings of the American Academy of Arts and Sciences, vol. xii. 1876, p. 75). — EDS.

they abound on many neighboring trees. The berry is globose, glossy, of a light champagne color, with a tinge of red when dried." *Fendl.* — The specimens are all fertile and in fruit; so that it is not known whether the plant has the anthers of the genus, but of this there is little doubt, as the species is apparently too closely allied to the *Phoradendron Californicum*, Nutt., which is "parasitic on a *Strombocarpus*." (Prosopis).[1]

282. ARCEUTHOBIUM OXYCEDRI, *M. Bieb.?* (*A. gracile*, Engelm. mss.). 283. A. OXYCEDRI, *M. Bieb.?* [59] (*A. robustum*, Engelm. mss.)

FROM GRAY'S PLANTÆ LINDHEIMERIANÆ, PART II. (BOSTON JOURN. NAT. HISTORY, VOL. VI. 1850).

PHORADENDRON FLAVESCENS (*Nutt.*): ramis teretibus; foliis oblanceolatis obovatis nunc orbiculatis obtusis [212] in petiolum brevem attenuatis trinerviis; spicis masculis subverticillatis folium æquantibus, articulis 4–5, 15–35-floris; fœmineis suboppositis folio brevioribus, articulis 3–4, 4–10-floris; floribus depresso-globosis annulato-carinatis

[1] The genus *Phoradendron* has recently been briefly indicated by Nuttall (in Jour. Acad. Philad. n. ser. 1, p. 185), but was unknown to Dr. Engelmann when he communicated to me the subjoined characters of *Viscum*, *Arceuthobium*, and *Spiciviscum*, Engelm., and of some species of the latter, the name of which I have necessarily changed to *Phoradendron*.

1 VISCUM, *Linn.* Flores dicœci *campanulati*. *Fl. masc.* Perianthium 4-fidum; *antheræ lobis totis adnatæ multicellulosæ, poris plurimis dehiscentes*. *Fl. fœm.* Calyx tubo cum ovario connato, margine integro, limbo obsoleto. Corolla 4-petala, summo calyci inserta. Ovarium inferum, uniloculare; ovulo unico pendulo: stigma sessile, obtusum, subbilobum. Bacca pulposa, corolla persistente coronata, monosperma. — Frutices gerontogei, foliosi, parasitici; foliis oppositis; floribus masculis glomeratis terminalibus; fœmineis in spicas articulatas breves terminales congestis, in quævis bracteæ axilla singulis.

I have examined only *Viscum album*, and based the characters on that species.

2. SPICIVISCUM, *nov. gen.* [lege PHORADENDRON]. Flores dicœci *globosi*. *Fl. masc.* Perianthium 3-(raro 2- s. 4-)lobum; *antheræ lobis imis adnatæ, transverse biloculares, poris s. rimulis verticalibus duabus dehiscentes*. *Fl. fœm.* Perianthium 3-(raro 2- s. 4-)lobum. Ovarium inferum, uniloculare; ovulo unico pendulo: stigma sessile obtusum. Bacca pulposa, perianthio persistente coronata, monosperma. — Frutices Americani foliosi s. aphylli, parasitici; floribus in spicas axillares longiores interruptas articulatas s. abbreviatas dispositis, sæpe pluribus supra quævis bracteæ axillam rhachidi immersis; bracteis abbreviatis connatis vaginulam pelviformem formantibus.

3. ARCEUTHOBIUM, *M. Bieb.* Flores dicœci, *ovati, compressi*. *Fl. masc.* Perianthium tripartitum, *antheræ lobis mediis adnatæ, globosæ, uniloculares, rimula transversa dehiscentes*. *Fl. fœm.* Perianthium brevissime stipitatum, bidentatum. Ovarium inferum, uniloculare; ovulo unico pendulo: stigma sessile conicum. Bacca (pulposa ?) corolla persistente coronata, monosperma. — Frutices gerontogei et Americani, aphylli, articulati; foliis ad squamas connatas pelviformes reductis; floribus axillaribus terminalibusque, masculis 1–3, fœmineis singulis.

PHORADENDRON, NUTT. [59]

* *Aphylla.*

1. [P. CALIFORNICUM, *Nutt. l. c.* Mountains of California. Perhaps same as the next.]

2. P. JUNIPERINUM, *Engelm. supra*. Santa Fé.

** *Foliosa.*

3. P. FLAVESCENS, *Nutt. l. c.*: ramis teretibus; foliis obovatis in petiolum attenuatis 3-nerviis, junioribus puberulis; spicis folio brevioribus; bracteis truncatis ciliatis; floribus in quovis articulo 6–10 depresso-globosis annulato-carinatis parce pubescentibus 3-(rarissime 2-)lobis. (*V. flavescens*, Pursh.) — On *Platanus* and *Ulmus*, in the woods of the lower Ohio and from there south; on *Populus*, along the Rio Grande below Santa Fé (*Dr. Wislizenus*). A well-known species; flowers half a line in diameter.

4. P. ORBICULATUM, *n. sp.*: ramis teretibus; foliis orbiculatis s. ovato-orbiculatis breviter et abrupte petiolatis indistincte trinervis pubescentibus demum glabratis; spicis folio brevioribus puberulis, etc., ut supra. — On different species of *Quercus*; on *Q. nigra*, sterile hills of Arkansas (*Engelm.*); on several oaks, San Felipe, Texas (*Lindheimer*). — Leaves on the older branches exactly orbicular, 6 to 10 lines in diameter; young leaves somewhat longer than wide. petioles a line and a half long: flowers half a line in diameter.

5. P. TOMENTOSUM: tomentosum; ramis teretibus; foliis obovatis s. oblanceolatis obtusis in petiolum brevem breve attenuatis, senioribus subtus obscure trinerviis; spicis masculis folium longe superantibus; bracteis truncatis, articulis elongatis multi-(15-25-)floris; spicis fœmineis folio subbrevioribus oppositis s. verticillatis ad apicem caulis paniculatim congestis, articulis brevioribus sub 8-floris; floribus immersis depresso-globosis annulato-carinatis puberulis 3-(rarissime 4-)lobis. (*V. tomentosum*, DC. Prodr. 4. p. 670). On *Algarobia* and one or two other *Mimoseæ*, near Rinconada, Northern Mexico, *Dr. Gregg*. — No doubt the same as De Candolle's plant, which was collected in Northern Mexico by Berlandier, also on *Mimoseæ*. Leaves an inch or one and a quarter long, and half as wide. Sterile spikes one and a half to two and a half inches long: female spikes only about an inch long: flowers very similar to those of both the foregoing species, and of the same size or rather smaller. Fruiting spikes slightly elongated, an inch to an inch and a half long: berries one line and three-fourths to two lines in diameter.

6. P. LANCEOLATUM, *n. sp.*: glaberrimum; ramis teretibus; foliis lanceolatis elongatis subfalcatis obtusiusculis in petiolum brevissimum sensim attenuatis 3–5-nerviis; spicis masculis folio brevioribus; bracteis triangularibus connatis; articulis 8–18-floris; floribus immersis globosis 3-(rarius 4-)lobis. — On "Live-Oak," Rinconada, *Dr. Gregg*. — Leaves 3 inches long, half an inch wide: sterile spikes an inch and a half to two inches long. Flowers less than a line in diameter; distinguished from those of the foregoing species by being destitute of the horizontal edge, and entirely glabrous, as is the whole plant. Anthers very distinct, similar to the common form of two-celled anthers, opening longitudinally, while in the other species they open by two pores. — Apparently near *V. Schiedeanum*, DC., but distinguished by the terete branches.

ciliatis subtrifidis. — Var. *a.* GLABRIUSCULUM : foliis oblanceolatis seu obovatis 3-nerviis in petiolum sensim attenuatis glabris; ramis junioribus puberulis. — *β.* PUBESCENS: foliis ut in *a.*, sed puberulis ; ramulis canescentibus. — *γ.* ORBICULATUM (*Ph. orbiculatum*, Engelm. Pl. Fendl.) : foliis obovato-orbiculatis in petiolum brevem abrupte contractis vix trinerviis subpubescentibus. — New Jersey to Southern Missouri and New Mexico, and south to Texas. Var. *a.* is the more northern form, mostly in low woods along water-courses ; *β.* in damp places on *Ulmus*, *Algarobia*, and also *Quercus falcata*, near New Braunfels, San Antonio, etc.; *γ.* in Texas and Arkansas on dry sterile land, on *Quercus nigra* and other oaks. Flowers, December to March ; fruit ripens the following winter.

The nearly related *Phoradendron tomentosum*, from south of the Rio Grande, has smaller leaves, longer spikes, etc. *Phoradendron villosum* of Oregon has much smaller and spatulate tomentose leaves, etc.

I take this opportunity to make some corrections and additions to my paper on *Viscum* and the related genera, printed as a note in Plantæ Fendlerianæ, pp. 58, 59.

I. VISCUM. . . . . Bacca globosa, pulposa, semipellucida, monosperma, corolla persistente coronata.

II. PHORADENDRON, *Nutt.* Flores diœci, globosi. *Fl. masc.* Perianthium 3-(raro 2-s. 4-)lobum : antheræ loborum basi adnatæ, transversæ, biloculares, poris s. rimis verticalibus duabus dehiscentes. *Fl. fœm.* Perianthium 3-(rare 2–4-)lobum: ovarium inferum, tubo adnatum, uniloculare ; ovulo unico pendulo. Stigma sessile, plus minus bilobum. Bacca globosa, pulposa, semipellucida, monosperma, perigonio persistente coronata. — Frutices Americani, etc.

* *Foliosa ;* foliis lamina dilatata basi attenuatis ; spicis fœmineis plus minus elongatis ex articulis pluribus plurifloris constitutis.

1. PHORADENDRON FLAVESCENS, *Pursh*, sub Visco. Vide supra.

2. PH. TOMENTOSUM, *DC.*, sub Visco.

3. PH. VILLOSUM, *Nutt.*, sub Visco : tomentosum ; ramis teretibus ; foliis oblanceolatis s. spathulatis obtusis in petiolum brevem attenuatis obscure trinerviis s. subenerviis ; spicis fœmineis oppositis s. verticillatis abbreviatis 2–3-articulatis ; bracteis truncatis; articulis brevibus, inferiore 6–8-floro, superiore 2-floro ; floribus depresso-globosis annulato-carinatis puberulis 3-fidis. — Wahlamet Woods, Oregon, *Nuttall.* — Leaves 8–12 lines long, 3–4 lines wide. Spikes 3–4 lines long. Flowers 0.5–0.6 of a line in diameter, like those of the two foregoing species depressed, with an almost annular, ciliate carina. Stigma conspicuously bifid. — The narrow, long, attenuate [213] leaves and the short spikes distinguish it from *Ph. tomentosum.*

5. PH. LANCEOLATUM, *Engelm. in Plant. Fendl.*

* * *Squamosa ;* foliis in squamulas connatas pelviformes reductis ; spicis fœmineis ex articulis paucis 1–2-floris constitutis.

6. PH. CALIFORNICUM, *Nutt.* : glabrum; ramis elongatis strictis gracilibus teretibus ; squamis ovato-lanceolatis patentibus basi connatis tenuiter ciliatis; spicis fœmineis lateralibus oppositis 3–4-floris ; floribus globosis trifidis glabris in quovis articulo singulis s. binis cupulæ ciliatæ immersis ; spicis fructiferis elongatis ; baccis globosis. — Sierra Nevada of California, on some species of *Strombocarpus*, Dr. Gambel. Intermediate and connecting the leafy and scaly species of this genus, though properly belonging to the latter. Scales longer than the diameter of the branch, patulous. Branches a foot or more long (*Nuttall*) ; ultimate joints 7–9 lines long ; flowering spikes about 3 lines, and fruiting spikes 9 lines long. Fruit 3 lines in diameter. Flowering spikes with 2 lateral linear-lanceolate ciliate bracts at base, consisting of 3 joints, the lower being always sterile, the two upper ones producing each two or by abortion single flowers. In the fruit-bearing spike these joints are in such a manner elongated that the (typically axillary) fruit is carried up to the top of the joint, just below the next pair of leaves (or scales). Stigma globose, very slightly bilobed.

7. PH. JUNIPERINUM, *Engelm. in Plant. Fendl.*

III. ARCEUTHOBIUM, *M. Bieb.* Flores diœci, ovati compressi. *Fl. masc.* Perianthium 3-(raro 4-)partitum. Antheræ lobis mediis adnatæ, unicellulosæ, rima transversa dehiscentes. *Fl. fœm.* Perianthium breviter pedicellatum, 2-(raro 3-)dentatum : ovarium inferum, tubo adnatum, uniloculare ; ovulo unico pendulo. Stigma sessile, conicum. Bacca carnosa, opaca, ovata, compressa, perigonio persistente coronata. — Frutices gerontogei et Americani glaberrimi, aphylli, articulati ; foliis squamæformibus in vaginulas pelviformes s. cupuliformes connatis ; floribus axillaribus terminalibusque sæpe spicam simplicem s. compositam mentientibus ; fl. masculis 1–3 sessilibus, fœmineis plerumque singulis brevissime incluso-pedicellatis ; baccis perigonio aucto plerumque discolore coronatis sæpius exserte pedicellatis extus carnosis intus viscidis.

1. A. OXYCEDRI, *M. Bieb.* : caule ramisque oppositis s. dichotomis compresso-teretibus gracilibus strictis ; ramulis ultimis compresso-subquadrangulatis ; squamis triangularibus in vaginulas pelviformes connatis ; floribus fœmineis in ultimis ramulorum articulis axillaribus terminalibusque in quavis axilla singulis s. binis ; baccis exserto-pedicellatis, erectis. — Southern Europe, etc. The specimen before me is from Fiume. — Lowest joints of the ultimate

branchlets sterile; the next joint producing two leaf-buds; the 2 to 4 following joints bearing flowers, one of which is terminal. The usual state probably is, where only the last two joints bear flowers, the ultimate one a terminal, and the next below two lateral flowers; that is the state described by DeCandolle: "floribus fœmineis ad ramulorum apices tribus." But in the specimen before me most branchlets bear from 5 to 9 flowers, on the last [214] three or four joints, one or two in each axilla. Flowers minute, 0.3 of a line wide and 0.4 long, on very short, enclosed pedicels, which apparently are elongated immediately after flowering. Pedicel of the young fruit (ripe fruits not seen) half the length of the fruit.

2. A. AMERICANUM, *Nutt.*: caule ramisque fasciculatis teretibus gracilibus patulis; squamis truncatis in vaginulas dilatatas cupuliformes connatis; floribus masculis axillaribus terminalibusque nec spicatis. — Oregon, on *Pinus*, Nuttall. — Considerably resembling the slender forms of var. *a.* of the next species, but smaller, slenderer, and at once distinguished by the terete branches, the fasciculated branchlets, and much dilated vaginulæ. Female plant and fruit unknown to me.

3. A. CAMPYLOPODUM, *n. sp.*: ramis oppositis seu dichotomis compresso-quadrangulatis; squamis truncatis breviter cuspidatis in vaginulas subcylindricas cupuliformes connatis; floribus axillaribus terminalibusque plerumque in spicam simplicem s. compositam aggregatis, masculis singulis vel binis ternisve, fœmineis in quavis axilla singulis; baccis exserto-pedicellatis patulis s. recurvis. — Var. *a.* MACRARTHRON: caule compresso vix angulato; ramis plerumque gracilioribus; articulis plus minus elongatis; floribus fœmineis sparsis et in ramulis brevibus paucis seu in spicas simplices aggregatis. — *β.* ? BRACHYARTHRON: caule tereti robusto; ramis robustis articulis abbreviatis diametro vix longioribus; floribus fœmineis in spicas densas compositas aggregatis. — I have comprised under this name different forms, which, when better known, will probably have to be separated as distinct species. My specimens are so incomplete that I cannot even satisfactorily determine whether the different forms which constitute the first of the two varieties will finally be retained under one species. — Var. *a.* has been found in Oregon (only on *Pinus ponderosa*), *Geyer;* in New Mexico (only on *Pinus edulis*), *Fendler*, 282; and in California, *Douglas.* — The specimens from New Mexico (only male and female flowers seen) have short female spikes, bearing 2 to 5 flowers, or the flowers are scattered on the branchlets: the flowers are elliptical, 0.4 line wide and 0.5 long, almost sessile. Geyer's Oregon plant (I have seen only a fruiting specimen) has more elongated many-flowered female spikes; the flowers apparently ovate; pedicel hardly one-third the length of the (not quite ripe) fruit. The Californian plant (male and female flowers and fruit) is much stouter: male flowers twice as large as in the specimens from New Mexico, and not rarely 4-parted; female flowers in more elongated spikes, elliptico-orbicular, small, 0.4 to 0.5 line in diameter; the recurved pedicel more than half the length of the fruit, which is 2 lines long and 1.3 wide. — Var. ? *β.* has been collected in Mexico by Coulter. I can hardly doubt it to be a distinct species; but my means to distinguish it are at present too limited. The stout terete stem, the short joints which are hardly longer than wide, the crowded compound or panicled spikes which resemble those of the following species, and the larger ovate (not elliptical) flowers appear to indicate specific distinction. Fem. flowers 0.6 line wide and 0.8 line long; fruit 2 lines long and 1.2 lines in transverse diameter, the pedicel more than half as long as the fruit: male flowers not seen.

4. A. CRYPTOPODUM, *n. sp.*: caule ramisque acute quadrangulatis robustis articulis brevioribus; squamis truncatis in vaginulas cupulatas connatis; floribus in spicas densas compositas congestis, fœmineis ovatis in quavis axilla singulis; baccis brevissime incluso-pedicellatis erectis. — Santa Fé, only on *Pinus brachyptera*, A. [215] Fendler, No. 283. — Hooker's *A. Oxycedri* from the Hudson Bay country appears to belong here: the figure shows at least subsessile, erect fruits; but the segments of the male flowers are broadly oval, while those of the New Mexican plant are lanceolate.

FROM THE TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS, VOL. III. 1873.

Dr. Engelmann exhibited a living specimen of the Black Spruce (*Abies nigra*) fresh from the Adiron- [lxxxiii] dacks of New York, infected with a diminutive parasite of the mistletoe family, which he had named *Arceuthobium minutum*. All the species of this genus inhabit Conifers. One occurs on Junipers in the Mediterranean and Caucasus regions of the Old World. A second was found by Humboldt on Pines on the highest mountains of Mexico; and several more have been found since on our Rocky Mountains and westward, mostly also on Pines. The peculiarity of this species, discovered about the same time last summer, by two different persons in different parts of the State of New York, besides its spring flowering (all the others being autumnal), consists in the occurrence of the sexes in distinct colonies in different trees, male and female plants never, thus far, having been found together on the same trees; and in the great abundance of individuals on these trees, where the flowering plants almost always occupy the three-year-old branchlets, while the two-year-old ones exhibit germinating plantlets like small knots. The necessary inference is that these parasites are propagated, or we should rather say multiplied, by stolon-like fibres, almost analogous to the mycelium of Fungi, spreading under the bark of the growing branches and always from the older to the younger

ones, rather than by seeds, which, though abundant enough, could not produce such a copious and regular crop, and invariably of one or the other sex only. Dr. Engelmann had been elaborating a monograph of this curious genus, which he would offer to the Academy for publication. — *Journal of Proceedings*, May 20, 1872.

From the Report on the United States Geographical Surveys west of the One Hundredth Meridian, Lieut. George M. Wheeler in charge, Vol. VI., Botany, by J. T. Rothrock, 1878.

Phoradendron flavescens, *Nutt.* — The collection contains a number of specimens, which represent two distinct forms, different from the common Eastern type. The first may be characterized as var. macrophyllum, with large orbicular-obovate, glabrate leaves, only in the young state with an evanescent pubescence, [252] $1\frac{1}{2}$–$2\frac{1}{2}$ inches long, 3- and often 5-nerved; staminate spikes unusually thick, with 4 or 5 short joints, each with 10–40, comparatively large, pubescent flowers. — They grow on soft woods (Ash, Willow, Poplar, Sycamore, and Sapindus) on the Gila and Bonita Rivers, and extend into Southern California, *G. K. Gilbert, Dr. Rothrock.*

Var. villosum (*Phor. villosum,* Nutt.), with woolly, obovate, and var. orbiculatum, with rounded, pubescent leaves, are found on hard woods, principally on oaks, in Oregon, California, Arizona, and southeastward. On the mountains about Camp Apache, Arizona, they grow on different varieties of *Quercus undulata.*

Phoradendron Californicum, *Nutt. Pl. Gambel. p.* 185. — Slender, terete, much-branched, leafless stems, 1–2 feet long, bearing, in the axils of the opposite, connate, acute, spreading scales, numerous short, pubescent, 1- or few-jointed spikes, each joint with 2–6 flowers; staminate flowers with oblong anthers, the cells opening longitudinally. — Arizona and Southern California, *G. K. Gilbert, Dr. Rothrock,* on *Mimoseæ, Larrea,* and a few other shrubs.

Phoradendron juniperinum, *Engelm. Pl. Fendl. p.* 58. — Half a foot to a span high, densely branched; small, obtusish leaf-scales ciliate; staminate spikes very short, mostly with a single 6–8-flowered joint, pistillate ones with only two opposite flowers. — Common on different species of Juniper throughout Arizona and in the adjacent districts; collected by all the different Expeditions. The short joints are so fragile that the dried specimens easily break up.

Arceuthobium Americanum, *Nutt.; Engelm. Pl. Lindh.* 214. — Slender, dichotomously and verticillately much branched, greenish-yellow; staminate plants, 2–4 inches high, $\frac{1}{4}$–1 line thick at base; fertile plants [253] much smaller; flowers small, staminate ones 1 line wide, lobes ovate-orbicular, acutish; pistillate flowers $\frac{1}{2}$–1 line, fruit 2 lines long. — Only on *Pinus contorta,* Rocky Mountains to Oregon and California; near Breckenridge, at 10,000 feet altitude, *Wolf,* 1873. Flowers late in autumn. — In this and the next species, accessory flowers or flowering branchlets are developed on the fruiting specimens, in this lateral, in the next dorsal to the fruits or fruiting branches. In these two we find no other secondary formation on the fertile plants, but in the other species sterile branchlets are developed on them which would flower in the following year; thus these latter continue their existence for a longer time than the first two.

Arceuthobium Douglasii, *Engelm. ined.* — Slender, small, $\frac{1}{4}$–1 inch high, greenish-yellow, dichotomously branched; branches suberect, single or with accessory ones behind the first; flowers in short, usually 5-flowered spikes, staminate ones less than 1 line wide, with orbicular-ovate acutish lobes; fruit $2\frac{1}{2}$ lines long. — On *Pseudotsuga Douglasii* from New Mexico (on Santa Fé River, *Rothrock,* No. 69, 1874) to Utah, *Parry, Siler,* and Northern Arizona, Camp Apache, *G. K. Gilbert* (109), 1873. — Flowers, May and June. — Similar to the last, but smaller, and never with verticillate branchlets or flowers, which are so common in that species. The thallus-like tissue or stroma, which creeps along within the bark of the nurse-plant, buds out in autumn all along the three-years-old shoot; after about twelve months, the flower-buds are formed, to open in the following spring, after which the life of the male plant is exhausted; but it takes another year to perfect the fruit. The female parasite, now fully three years old, generally dies, but sometimes lives and fructifies another season. The Northeastern *A. pusillum,* Peck, behaves in the same manner, while in *A. Americanum* and some other species the buds of the parasite make their appearance at first only among the older bud-scales of the pine branch.

Var.? microcarpum is parasitic on *Picea Engelmanni,* found by Mr. Gilbert in 1873 (100 and 102) in the Sierra Blanca, Arizona; it is a little taller, 1–2 inches high, but has much smaller fruit, only $1\frac{3}{4}$ lines long, the smallest of any American species.

Arceuthobium divaricatum, *Engelm. ined. A. campylopodum,* var., Engelm. Pl. Lindh. — Much stouter [254] than the last, 2–4 inches high, below 1 line in diameter, olive-green or light brownish; branches spreading, often recurved; staminate flowers few and scattered, or in 3–7-flowered spikes, 1 line in diameter, with ovate, acute lobes; inflorescence often bearing sterile branches from the same axils as the fruiting ones and behind them; fruit $1\frac{1}{2}$–$1\frac{3}{4}$ lines long.

On Nut-pines (*P. edulis* and *monophyllos*) from Southern Colorado through New Mexico to Arizona, *G. K. Gilbert,* 1873 (116), *Dr. J. B. Girard,* 1874. Flowers, August and September. Intermediate in size and color between the last and the following; well marked by its divaricate habit and its scanty flowers.

ARCEUTHOBIUM ROBUSTUM, *Engelm. Pl. Fendl. p.* 59 ; *A. cryptopodum*, Engelm. Pl. Lindh. p. 214. — Stout, 2–4 inches high, 2–3 lines thick at base, paniculate, much branched, brownish-yellow to dark olive-brown ; staminate plants smaller than the pistillate ones ; staminate spikes with much-compressed, adpressed buds ; flowers mostly 3-parted, $1\frac{1}{4}$–$1\frac{1}{2}$ lines wide ; anthers attached above the middle of the ovate, acute lobes ; ripe fruit $2\frac{1}{3}$ lines long.

Only on *Pinus ponderosa*, Colorado, New Mexico, and Arizona ; Camp Apache (*C. K. Gilbert*, 1873) and Mount Graham (*Rothrock*, 787), 1874. Flowers in June. Fruit mature in August and September. The closely allied *A. occidentale*, Engelm., is distinguished by more elongated spikes, ventricose, divaricate buds of the staminate, mostly 4-parted, larger flowers, with lanceolate, acuminate lobes and anthers attached below their centre ; it also occurs on *Pinus ponderosa*, but more frequently on other conifers. Both persist for several years, the female plants always longer than the male.

FROM THE BOTANY OF CALIFORNIA, VOL. II., BY SERENO WATSON, CAMBRIDGE, 1880.*

PHORADENDRON, NUTT.

* Leaves foliaceous, mostly dilated upward from a narrow base. [105]

1. P. FLAVESCENS, *Nutt.* Branches terete, pubescent when young (as also the spikes), often a foot long or more: leaves oblanceolate to obovate or orbicular, ½ to 2 inches long, obtuse, 3-nerved, at last glabrous : bracts connate into a short truncate cup : flowers depressed-globose, the calyx-lobes ciliate on the margin : staminate spikes opposite or verticillate, usually shorter than the leaves, 3–7-jointed, the numerous flowers mostly in 4 to 6 rows on each side and occupying nearly the whole joint, very fragrant with the odor of pond-lilies ; anthers transverse, opening by 2 pores : pistillate spikes usually opposite, shorter (rarely 5–6-jointed), the flowers (2 to 7 on each side of a joint) in not more than three series : berries white, 2 lines in diameter. — Engelm. Pl. Lindh. 212. *Viscum flavescens*, Pursh, the common glabrate spatulate-leaved southeastern form.

Var. MACROPHYLLUM, *Engelm.* Leaves large (2 to $2\frac{1}{2}$ inches long), broad, often 5-nerved, glabrate : flowers larger, in stout short-jointed spikes. — Wheeler's Rep. vi. 252.

Var. VILLOSUM, *Engelm. l. c.* Leaves small or middle-sized, orbicular to spatulate, permanently pubescent or tomentose : spikes slender, rather short. — *P. villosum*, Nutt. l. c. ; Engelm. Pl. Lindh. 212.

The latter variety is common throughout the State, chiefly on oaks, from S. California to Oregon, and eastward to New Mexico and Texas ; the former occurs on *Populus, Platanus, Fraxinus* and other trees, from S. California to New Mexico. Var. TOMENTOSUM (*Viscum tomentosum*, DC.) is found in Northern Mexico, on *Mimoseæ*, and is densely tomentose, with slender elongated spikes.

2. P. BOLLEANUM, *Eichler.* Puberulent, at length glabrous : branches terete, less than a span long : leaves thick, spatulate to linear, 6 to 12 lines long by 1 to 3 wide, nerveless, obtusish : spikes opposite or rarely in fours, with connate minutely ciliate bracts ; the staminate of two 6–12-flowered joints, the fertile of a single 2-flowered joint : anthers transverse, opening by pores : fruit white, $1\frac{1}{2}$ lines in diameter. — Fl. Bras. v^2. 134^m. *Viscum Bolleanum*, Seem. Bot. Herald, 295, t. 63. *P. pauciflorum*, Torrey, Pacif. R. Rep. iv. 134.

On conifers, mostly *Juniperus*, from the Geysers (*Brewer*) to San Felipe (*Palmer*) and into Arizona and Mexico ; also on Guadalupe Island, *Palmer*. A specimen on *Abies concolor*, from Duffield's Ranch near Auburn (*Bigelow*), is larger and with larger broader leaves.

* * Leaves reduced to short mostly connate scales : spikes opposite, mostly few-flowered.

3. P. CALIFORNICUM, *Nutt.* Pubescent or at last glabrous : branches terete, slender, a foot or two long : scales broadly ovate, acute, spreading : staminate spikes of 2 or 3 (rarely 5) flower-bearing joints, each with 2 to 6 ovate-subglobose flowers : anther-cells oblong, opening by a longitudinal slit : fertile spikes sometimes with nearly as many joints and flowers, the joints elongated (often an inch long) in fruit : berries reddish, 2 lines wide. — Pl. Gambel, 185 ; Engelm. Pl. Lindh. 213.

Southern California and Arizona, on various *Mimoseæ* and *Cassieæ, Larrea*, etc.

4. P. JUNIPERINUM, *Engelm.* Glabrous, stout, densely branched, 6 to 9 inches high : branches terete, the ultimate branchlets quadrangular : scales broadly triangular, obtusish, connate or distinct, ciliate : staminate spikes of a single 6–8-flowered joint (rarely two) : anthers transverse, opening by pores : pistillate spikes 2-flowered : berry globose, whitish or light red, $1\frac{1}{2}$ lines wide. — Pl. Fendl. 58.

Var. LIBOCEDRI, *Engelm.* Branches a foot long or more, slender : joints more elongated, the ultimate ones more sharply quadrangular.

On different species of *Juniperus*, from Truckee Pass southward and through S. Nevada and Arizona to New Mexico : the variety on *Libocedrus decurrens*, from the Yuba River to San Bernardino.

* The generic characters are omitted from this paper, having been given elsewhere. As stated on p. 104, only the following species of *Phoradendron* are found within the limits of the United States. — EDS.

ARCEUTHOBIUM. A small genus, represented in S. Europe by a single species, and in America ranging from the northern border of the United States to Mexico, chiefly in the mountains. [106]

* Staminate flowers all (or nearly all) terminal on distinct peduncle-like joints, paniculate.

1. A. AMERICANUM, *Nutt.* Slender, dichotomously or verticillately much-branched, greenish yellow; staminate plants sometimes 3 or 4 inches long (¼ to a line thick at base), fertile plants much smaller: flowers small, the staminate a line broad or more, with ovate-orbicular acutish lobes, the pistillate a half to one line long: fruit 2 lines long. — Engelm. Pl. Lindh. 214, and Wheeler's Rep. vi. 252.

Only on *Pinus contorta* (and apparently *P. Banksiana* in the Saskatchewan region), from Wyoming to Oregon and southward to Colorado and California (Little Yosemite Valley, *Bolander*). Flowering mostly late in autumn apparently, but found by Parry in Wyoming in flower in July; fruit mature in August and September. Its shoots creep along within the tissue of the bark on young branches of the pine, and in the autumn bud out in the form of little knobs among the bud-scales at the end of three-years-old limbs, developing into flowering plants the next season. When once established it may continue to sprout from the same base for many (30 or more) years, causing hypertrophy of the wood and bark of the limb and often its final destruction. Fruiting and flowering branchlets are often seen in juxtaposition in the same whorl, but without leaf-bearing branchlets, and never in superposition.

The type of the genus, *A. Oxycedri*, Bieb., of the Old World, is allied to this, but distinguished from it and from all American species by its staminate flowers being all terminal on short branchlets and usually in threes, scarcely a line wide and with orbicular lobes, and by the much smaller oblong fruit, less than 1½ lines long. The northeastern *A. pusillum*, Peck, of the Adirondacks, growing on *Picea nigra*, also belongs to this section.

* * Staminate flowers axillary (with a terminal one), forming simple or compound spikes.

+ Slender, greenish-yellow: accessory branchlets of fruiting specimens flower-bearing.

2. A. DOUGLASII, *Engelm.* Similar to the last, but smaller, ¼ to 1 inch high: branches suberect, solitary, or with accessory ones behind (never beside) the primary ones: flowers in short (usually 5-flowered) spikes; the staminate less than a line wide, with orbicular-ovate acutish lobes: fruit 2½ lines long. — Wheeler's Rep. vi. 253.

Var. ABIETINUM, *Engelm.* A larger form, 1 to 3 inches high (the fertile smaller), with spreading or even recurved few-flowered branchlets: staminate flowers 1¼ lines wide: fruit scarcely 2 lines long.

On *Pseudotsuga Douglasii*, from New Mexico to S. Utah and N. Arizona; the variety on *Abies concolor*, in Sierra Valley (*J. G. Lemmon*) and S. Utah, *Parry*. Flowering apparently in October. Distinguished from the last by its usually smaller size, the superimposed (never verticillate) accessory branchlets, lateral flowers, and larger fruit. Its creeping stroma buds out all along the branch, and not between the bud-scales only as in the last. Another variety, with very small fruit, is found on *Picea Engelmanni* in Northern Arizona. [107]

+ + Stouter, greenish-brown: accessory branchlets of fruiting specimens mostly leaf-bearing.

3. A. DIVARICATUM, *Engelm.* Stouter than the last, 2 to 4 inches high and a line in diameter at base, olive green or pale brownish; branches spreading, often flexuous or recurved: staminate flowers few and scattered or in 3–7-flowered spikes, a line wide, with ovate acute lobes: fruit 1½ to 1¾ lines long. — Pl. Wheeler, 1874, 16, and Wheeler's Rep. vi. 253. *A. campylopodum*, var., Engelm. Pl. Lindh. 114.

On *Pinus edulis* and *P. monophylla*, from New Mexico and S. Colorado to Arizona and S. Utah, and to be looked for on the latter species in S. California. Flowering in August and September. Intermediate in size and color between *A. Douglasii* and the following species, but well characterized by its slender habit, spreading growth, and small and rather scanty male flowers.

4. A. OCCIDENTALE, *Engelm.* Stout, 2 to 5 inches high, 2 to 2½ lines thick at base, paniculately much-branched: staminate plants brownish yellow, smaller, the pistillate commonly of a darker olive-brown color: staminate flowers in long dense spikes, often 9 to 17 on a single axis, their buds ventricose with the upper edge curved outward; calyx 3–5- (usually 4-) parted, 1½ to 2 lines wide; anthers sessile below the middle of the lanceolate acuminate lobes: fruit 2½ lines long.

Var. ABIETINUM, *Engelm.* More spreading and less densely branched, the accessory branches in the fruiting plant bearing fertile flowers as often as they do leaf-buds. — *A. abietinum*, Engelm. Proc. Amer. Acad. viii. 401.

On various conifers of the Coast Ranges and Sierra Nevada (*Pinus insignis*, *P. Sabiniana*, and *P. ponderosa*), from Salinas Valley and Walker's Basin to Oregon. It is the only American species found also on *Juniperus* (Silver Mountain, *Brewer*). The variety occurs on *Abies grandis* in the valley of the Columbia, *Hall*. Flowering in August and September.

The closely allied A. VAGINATUM, *Eichler* (*Viscum vaginatum*, HBK.), upon the pines of the Mexican mountains, of which only incomplete material has been collected, has shorter spikes and smaller mostly 3-parted staminate flowers with broader and shorter lobes. A. ROBUSTUM, *Engelm.*, on *Pinus ponderosa* in the Rocky Mountains and Arizona, has shorter spikes than *A. occidentale*, with shorter flat appressed staminate buds, the 3-parted flowers

(opening in June) with shorter and broader lobes, bearing the anthers above their middle. Of the only remaining known species of this curious genus Seemann gathered on the Sierra Madre of Mexico a staminate specimen, in bud only, which is distinguished from all others by its greater thickness and by the long spikes of large verticillate 4-parted flowers, mostly 6 in a whorl. It may therefore bear the name A. VERTICILLIFLORUM.

IX. SPIRODELA.

FROM THE BULLETIN OF THE TORREY BOTANICAL CLUB, VOL. I. 1870.

IN reply to a recent communication of specimens, we have received the following letter [42] from Dr. Engelmann. Although he thinks the publication unnecessary, we yet venture to print it, as he differs from Mr. Austin in relation to the endopleura, and, of course, the subsequent terms of the series. Mr. Austin notified us that he had not had access to his materials for comparison with other species. — *Editors of the Bulletin.*

Only to-day I finished the examination of your interesting *Lemna*. As Prof. Hegelmeier, the accurate monographer of the family, will no doubt give us a full description and figure of this plant, from your specimens, I think it superfluous to try to anticipate him in a much less complete and satisfactory manner, but I may say that the fertile fronds are unusually small, only $2\frac{1}{2}$–$3\frac{1}{4}$ mm. in the longer diameter, mostly with 5–6 ribs, or at most 7; and with 3–5 or sometimes 6 roots. *Foliaceous organs;* spiral vessels (even in the roots), pigment cells, and both forms of crystals, acicular and glomerate, as in the common form of *polyrrhiza;* stomata smaller, only 0.14–0.16 mm. in larger diameter (whereas in that they are 0.20–0.25 mm. long). — *Spathe* a complete sac, as in *Lemna trisulca, gibba,* and *minor;* not a mere circular bract, as in *L. paucicostata* and others. — *Anthers,* $\frac{1}{3}$ mm. in transverse diameter, larger than those of other species, different from those of all *Lemnæ* (and thus confirming the genus *Spirodela*), by longitudinal and not transverse dehiscence, as, in fact, Hegelmeier already surmises from Griffith's coarse but reliable figures of the East Indian plant. *Pollen-grains* spinulose, as in the whole family, as often elliptical as globose, 0.018–0.023 mm. in the different diameters and sizes; smaller than those of our *Lemna paucicostata* (0.023–0.027 mm.). — *Pistil,* as well as anthers and utricle, strongly dotted with purple (in alcohol, brown), subcuticular cells — *ovule,* hemitropous; horizontal, as in *L. minor;* and, in the 10 or 12 flowers now examined, *always single;* spiral vessels in funiculus, which only occur again in *L. gibba,* [43] in this family; exostome almost closed, while in all others it is open or even (in *L. paucicostata* and *perpusilla*), incomplete, with the endostome strongly protruding. — *Seed* horizontal and slightly compressed, the dark spot of the chalaza distinctly visible, even through the utricle, and, as in all 1-ovuled species of *Lemna,* directed backward to the base of the frond; rhaphe distinct, no spiral vessels observed in it; seed (apparently — the specimens examined were not completely matured) smooth as in *Wolffia,* not ribbed as in *Lemna;* cellular spongy testa very thick; operculum distinct; endopleura, as usual in *Lemnæ,* dark brown, thin; endosperm (albumen) considerable. — *Embryo* cylindric, almost as long as the seed, as usual in the family [what Austin calls albumen "a," his "s" is the starchy albumen; what he calls embryo is the plumule]. I take it to be a mostly 1-ovuled small form of *S. polyrrhiza.*

In all the specimens examined I find the singular circumstance of the first (anterior) stamen only being developed and protruding (but never as far as in other species), and the second or posterior one and the pistil being enclosed. Is this owing to the hour of the day when collected? It would be worth while to find out whether in *Lemna* the first stamen may be developed in the morning, and the second at noon or in the afternoon.

Nov. 13, 1870.

X. SPECIES OF ALISMACEÆ.

From Torrey's Botany of the Mexican Boundary (Report, etc., Vol. II. Part 2, 1859).

Sagittaria calycina, *Engelm. mss.* var. *α.* maxima, var. *β.* media, var. *γ.* fluitans. S. longiloba, *Engelm.* [212] *in herb.* (*S. simplex*).

From Gray's Manual of the Botany of the United States.

First Edition, 1848.

ECHINODORUS, *Richard, Engelmann.* E. subulatus, *Engelm.* (*Alisma subulata*, L.) [460]. E. rostratus, *Engelm.* (*Alisma*, Nutt.). E. radicans, *Engelm.* (*Sagittaria*, Nutt.). Sagittaria variabilis, *Engelm.* [461].

Second Edition, 1856.*

Echinodorus parvulus, *Engelm.* E. rostratus, *Engelm.* E. radicans, *Engelm.*

1. *Sagittaria falcata*, Pursh. 2. S. variabilis, *Engelm.* (*S. sagittifolia*, Amer. auth., &c.) — Var. ob- [439] tusa (*S. obtusa*, Willd.). — Var. latifolia (*S. latifolia*, Willd.). — Var. diversifolia. — Var. sagittifolia. — Var. angustifolia. — Var. gracilis (*S. gracilis*, Pursh). 3. *S. heterophylla*, Pursh. — Var. elliptica. — Var. rigida (*S. rigida*, Pursh). — Var. angustifolia. — Var. fluitans. 4. *S. simplex*, Pursh (*S. acutifolia*, Pursh, &c.). *S. pusilla*, Nutt. (Alisma subulata, *Pursh*). *S. natans*, Michx. [440]

Fifth Edition, 1868.

In addition to the species of the previous edition, this contains *Sagittaria lancifolia*, L. (S. falcata, *Pursh*). *S. variabilis*, Engelm., var. hastata (including *S. hastata*, Pursh). — Var. pubescens (*S. pubescens*, Muhl.). S. calycina, *Engelm.* — Var. spongiosa. — Var. fluitans. — Var. grandis. *S. graminea*, Michx. (*S. acuti-* [494] *folia*, Pursh. *S. simplex* of Amer. authors, not of *Pursh*). — Var. platyphylla.

From Additions to the Flora of the United States (Bull. Torrey Bot. Club, Vol. IX. 1882).

Sagittaria natans, Michx., has been noticed by Mr. C. E. Faxon, since a number of years in Charles River, [4] Mass., "at the depth of 2 to 4 feet, and entirely above the influence of tide-water," and also, as he informs me, in Neponset and in Ipswich Rivers, where Mr. J. Robbinson found it. It flowers there from the middle of June to the end of July, but never perfects fruit, and thus is evidently not at home in those northern waters, where it has a precarious existence by stolons; these can only winter where deep water protects them from frost. The seed was probably first brought there from the South by water-fowl who disseminate so many water-plants. Scape and phyllodia 2–4 feet long, barely reaching the surface of the water, leaf-blades rarely developed, and then linear-lanceolate; raceme as well as pedicels often elongated in order to reach air and light; flowers 6–7 lines wide, opening in forenoon, submerged again toward evening, only one or two of the lowest whorl fertile, the others all male; male flowers with 6 exterior and 1 or 2 central stamens; filaments about as long as the nearly orbicular anthers, bulbous at base and smooth; pistils of the female flowers numerous, minute, erect, style as long as the ovary; fruit (never matured in the North) in southern specimens marked by several (5 or 7) denticulate crests on back and sides. *Sagittaria pusilla*, Pursh, must be considered as a subterrestrial form of this species, distinguished only by its size, and by a 3-crested achene. *S. graminea*, with which I had confounded the northern form, is distinguished by the great number of [5] stamens and the papillose filaments, even where the fruit cannot be compared.

XI. TWO NEW DIŒCIOUS GRASSES OF THE UNITED STATES.

From the Transactions of the Academy of Science of St. Louis, Vol. I. 1859.

The grasses, though usually hermaphrodite, show a tendency to a separation of the sexes, [431] and polygamous flowers are not rare among them. About 25 to 28 genera, one-twelfth of the whole number known, comprising only 75 to 80 species, about one seventy-fifth of all species,[1] are described as having monœcious and mostly heteromorphous flowers.

* The entire account of *Echinodorus* and *Alisma* in this and the fifth edition was contributed by Dr. Engelmann, but the work is so easily accessible that only an enumeration of the species is undertaken here. *Sagittaria stolonifera*, Engelm. & Gray (*S. graminea*, Nutt.) is characterized by Gray in Pl. Lindheim., part 1, pp. 26, 27. — Eds.

[1] In the latest work on Grasses, *Steudel's Glumaceæ*, published in 1855, about 6,000 species of grasses are described,

Only two genera of diœcious grasses are known to the books; of these, *Spinifex*, Linn., with 6 species from the East Indies and Australia, bearing on some plants staminate and on others complete flowers, is only incompletely diœcious; the other genus is *Gynerium*, HBK., with five South American species. Some other diœcious species of genera, generally hermaphrodite, are noticed; such as *Calamagrostis dioica*, Lour., and *Guadua dioica*, Steud. The unisexual grasses mostly belong to *Oryzeæ*, *Phalarideæ*, *Paniceæ*, and *Rottbœllieæ;* none have been known among the tribes *Stipeæ*, *Agrostideæ*, *Chlorideæ*, *Avenaceæ*, *Festuceæ*, and *Hordeeæ*. They were unknown in the northern temperate zone, with the exception of *Zizania* and *Tripsacum* of North America and the cultivated *Zea*, all with heteromorphous staminate and pistillate flowers on the same plant. The diœcious grasses of our Flora are both species of *Brizopyrum;*[2] *Eragrostis reptans* is mostly diœcious, and other species of this genus seem to be imperfectly so. In the following pages two new diœcious North American grasses are described, both types of new and very distinct genera, and both, it is believed, belonging to *Chlorideæ*.

BUCHLOË, Nov. Gen.

Flores diœci, heteromorphi. [432]

Planta mascula: spiculæ 2–3-floræ, in spicis unilateralibus distichæ. Glumæ duæ uninerviæ; inferior multo minor. Paleæ duæ, æquilongæ, glumas excedentes; inferior trinervis, mucronata; superior binervis mutica. Squamulæ binæ, truncatæ, emarginatæ. Stamina tria; antheræ lineares. Ovarii rudimentum nullum.

Planta fœminea: spiculæ unifloræ in spicas 1–3 breves capituliformes obliquas vaginis foliorum superiorum involucratas congestæ; flosculo summo tabescente squamam involuciformem trifidam simulante. Glumæ duæ; spiculæ infimæ gluma inferior 1–3-nervis, apice herbaceo lanceolato-subulata seu 2–3-fida, latere inferiore glumæ superioris dorso adnata; glumæ reliquarum spicularum inferiores (quoad capitulum internæ) liberæ, multo minores, membranaceæ, ovato-lanceolatæ, acutæ, uninerves; glumæ superiores (externæ) basi cum rhachi incrassata connatæ involucrum simulantes demum lignosum, quassi osseum, ovatæ, enerviæ, pallidæ, apice herbaceo nervoso trifidæ. Palea inferior (quoad capitulum interna) brevior trinervis, herbaceo-tricuspidata; palea superior brevior binervis. Squamulæ ut in floribus masculis. Staminorum rudimenta 3 minuta. Ovarium lenticulare, brevissime stipitatum glabrum; stigmata stylis 2 erectis terminalibus multo longiora, pilis simplicibus plumosa, ex apice floris exserta. Caryopsis libera, in capitulo osseo, demum toto deciduo inclusa, sublenticularis, extus (versus paleam inferiorem), ubi embryo, plana, intus convexa.

Gramen planitierum Americæ Septentrionalis aridarum Missouriensium, Texensium, Mexicanarumque gregarium, perenne, stoloniferum, humile, sparse pilosum vel glabriusculum; ligulis barbatis. — *Buchloë*, pro nimis longo *Bubalochloë* nomen vernaculum "Buffalo-grass," græce reddit.

BUCHLOË DACTYLOIDES.

Syn. plantæ masculæ: *Sesleria dactyloides*, Nuttall, Gen. i. p. 64. *Sesleria* (?) *dactyloides*, Torrey, in Emory's Rep. 1848, p. 153, Pl. X.; id. in Whipple's Rep. Pacif. R. R. Expl. iv. p. 157. *Calanthera dactyloides*, Kunth (?) in Hooker's account of Geyer's Rocky Mountain plants, in Kew Journ. Bot. viii. p. 18. *Triodiæ spec.*, Bentham, in Pl. Hartweg, no. 250, p. 28. *Lasiostega humilis*, Rupprecht (ined.) in Benth. Pl. Hartw. Corrig. p. 347. — Drummond, Tex. iii. no. 378. Lindheimer, Pl. Tex. exsicc. 569. Fendler, N. Mex. 940. Berlandier, no. 1612 and 1614. Hartw. 250 (fide Gray).

Syn. plantæ fœmineæ: *Antephora axilliflora*, Steudel, Glum. i. p. 111. — Drummond, Tex. ii. 359. [433] Wright, 1849, 785; 1851–52, 2079 (fide Torrey).

This remarkable plant is found in our western prairies from the British Possessions throughout the Missouri territory, Nebraska, Kansas, and New Mexico, down to Texas and Northern Mexico, and is, under the name of "*Buffalo-grass*," well known to hunters and trappers as one of the most nutritious grasses, on which, for a part of the year, subsist and fatten the immense herds of buffalo and the cattle of the hunter and the emigrant. Since the time

very unequally distributed in about 300 genera, many genera containing only a single species, while *Panicum* alone comprises 864, *Andropogon* 461, *Eragrostis* 247, and *Festuca* 239 numbers.

[2] *Brizopyrum spicatum*, Hook, is from the eastern sea-coast, and *B. strictum*, Torr., from the saline soils of the Missouri region and of Utah. The flowers of both sexes are conform, but the staminate plants are readily distinguished from the pistillate ones by their more slender growth, the spikes overtopping the leaves; while in the pistillate plants the latter are longer than the spikes.

Plate XII. — Buchloë dactyloides.

of Nuttall, who published an account of it, in his "Genera," as early as 1818, the male plant has been collected by almost every botanist traversing those regions. The female plant had escaped the observers until it was described by Steudel, in the year 1855, from Drummond's Texan specimens, as a totally different plant and belonging even to a different tribe. Though Prof. Torrey had already, in Emory's Report, 1848, suggested the probability of the Buffalo-grass being a diœcious plant, the possibility that Nuttall's *Sesleria dactyloides* and Steudel's *Antephora axilliflora* could be the male and the female of the same species was not even suspected, till finding both together in a collection sent by my brother, Henry Engelmann, who, as geologist, accompanied the topographical corps attached to the army of Utah, I was struck with their similarity. My surmise, much doubted at first, became a certainty when I discovered among some male plants, collected by A. Fendler, about Fort Kearney on the Platte River, a monœcious specimen, showing both male and female flowers on different stalks from the same rhizoma. A figure of this important specimen is given on Pl. XII. Fig. 3.

That our plant is distinct from *Sesleria* has already been stated by Torrey (l. c. p. 154), and indeed by Nuttall himself (l. c. p. 65), and both have pointed to its affinity to *Atheropogon* or *Chondrosium*. The description now given fully confirms both positions. It also leaves no doubt that it is not an *Antephora*, nor at all paniceous. A new generic name, therefore, had to be given, and I have preferred to propose an abbreviated translation of the popular and widely known name of "Buffalo-grass," retaining of course Nuttall's original specific appellation. The synonymes of the male plant, supplied through the kindness of Prof. Gray, are uncertain, Kunth never having published such a name as *Calanthera*, which, moreover, is quite unmeaning; nor can I learn that a genus *Lasiostega* has ever been described.

The Buffalo-grass grows in dense tufts, sending out stolons. These, in most herbarium specimens, are only a few inches long, with internodes of ½–2 inches in length; Lindheimer, however, sends specimens from [434] New Braunfels, Texas, with stolons 1–2 feet long, the internodes often measuring over 3 and even as much as 5 inches. The male plant seems to throw out more numerous runners than the female, and may often overspread and kill it out, which would account for the much greater scarcity of the latter.

Leaves 2–4 inches long, ½–1½ lines wide, sparsely hairy or ciliate or glabrous; sheaths striate, glabrous, strongly bearded at the throat.

The flowering stems of the male plant are 4–6 or rarely 8 inches high, mostly glabrous or very sparsely hairy, generally longer than the leaves, and bear 2 or 3 alternate oblique one-sided spikes. These spikes are 3–6 lines long, and bear on the lower, outer side of the flattened, dentate, pubescent rhachis 6–15 minutely puberulent spikelets, alternate in two rows; the uppermost spikelet is usually abortive, and is represented by a bristle. The spikelets are 2 or rarely 3 lines long, with 2 or sometimes 3 subterete flowers; they are, as usual among chlorideous grasses, somewhat obliquely distorted; the glumes are broader on their lower side, but turning upwards, towards the upper end of the spike, they cover the upper edge of the flowers, leaving the lower edge free. The smaller lower glume is, as in this whole tribe of grasses, inside of the spike, and the larger upper one outside and much more conspicuous.

Lower glume ovate-lanceolate, with a scarious margin, convex, scarcely carinate, one-nerved, obtuse or acutish or mucronate, one-third or one-fourth the length of the flower; on the uppermost spikelet of each spike, it is much larger, and almost equal to the upper glume.

Upper glume twice as long as the lower one, much wider, ovate, obtusish, with a strong middle nerve which sometimes runs out into a point or a short awn between two membranaceous teeth; in a specimen from Fort Kearney, I find on the lower side a second nerve running out into a lateral tooth; a third nerve on the upper side is very indistinct; other spikelets of the same specimen show the ordinary structure.

Lower palea convex, obtusish, 3-nerved, middle nerve in the lower flower running out into a mucro, in the upper one mostly even with the membranaceous margin.

Upper palea as long as, or a little exceeding, the lower one, which partly envelops it, 2-nerved, 2-carinate, obtuse and scarious at tip.

Scales (*lodiculæ*) 2 at the margin, and inside of the lower palea, minute, triangular-truncate, undulate or emarginate.

Stamens 3, scarcely exceeding the paleæ; anthers linear, bifid at both ends, 1 line long; filaments much shorter. Pollen-grains of the dry anther, immersed in water, globular, smoothish, 0.017 line in diameter. [435]

The stalk of the female plant is much shorter than the leaves, usually 1½–2 and very rarely 3–4 inches high; it is leafy to the top, the broad, ventricose, many-nerved sheaths of the 2 or 3 uppermost leaves serving as involucres for the flower-heads. These heads, 3–3½ lines long, are usually 2 in number, one almost sessile between both top leaves and on the side of the lower one, the other on a flattened pedicel on the side of the upper leaf; sometimes a third head is noticed still higher, and on the side of the lowest one. The pedicels of these heads are nothing but the common peduncle or rhachis terminating the stem, and the heads themselves correspond to as many lateral spikes of the male plant, in position as well as in structure; they are only more contracted, consist of fewer, one-flowered spikelets, and turn obliquely upwards, while the male spikes turn obliquely downwards. Where the number of spikelets does not exceed 3, the head is ventricose-cylindric, or, in fruit, subglobose; but when the number is larger,

it is compressed and laterally elongated, showing distinctly enough the biserial arrangement. The pistillate spikelets are, like the staminate ones, arranged so that the lower glume is inside and the upper one outside in the head.

The thick rhachis of these heads is firmly united with the upper glumes, which in fruit become ligneous; they have a pale whitish or straw color, and smooth and shining surface, with a few scattered hairs; at maturity they separate entire from the common peduncle, at the insertion of which a tuft of short hair is noticed.

The lower glume is a small triangular or ovate, obtuse, acute or acuminate, 1-nerved, carinate scale, completely hidden in the interior of the head. The lower glume of the lowest spikelet only is larger, with 2 or 3 foliaceous points, turned half outside, and with its lower edge united to the back of the corresponding upper glume.

Upper glumes much larger, the largest organ of the spikelets, convex outside, concave inside, broadly ovate, narrowed at base, and separated there from one another by a deep and rounded sinus; terminating into 3 herbaceous, nerved, lanceolate-linear lobes, a larger central and 2 smaller lateral ones.

Lower palea, of course, opposite the upper glume and therefore turned towards the centre of the head, much smaller, also 3-pointed, with two further lateral membranaceous teeth, enveloping the upper palea. Upper palea still smaller, 2-nerved, membranaceously 2-pointed. Scales similar to those of the staminate flowers. [436]

Three minute rudimentary stamens at the base of the short-stipitate, compressed, lenticular ovary, which at the apex bears 2 rather short, erect styles and elongated stigmata, protruding from the apex of the flower. Hair of the stigma simple, rather short and scarcely dentate.

Mature head ventricose, thick, extremely hard, enclosing the loose grain. Grain about 1 line long, orbicular, ovate, flat on the outer (turned towards the lower palea and inside of the head) and convex on the inner face, 2-pointed at the apex by the persistent bases of the styles. Embryo on the flat, outer side of the grain and almost as long as it.

Each spike or head has, with very rare exceptions, at the upper end an incomplete rudimentary spikelet, consisting of a single 2–3-pointed upper glume. This, with the similar-looking lower glume of the lowest spikelet, seems at first glance to form an involucrum for the head; or the upper glumes together have been taken for an involucrum; the lower glumes were overlooked, and the plant placed with the paniceous genus *Anthephora*, Schreb., which is closely allied to *Cenchrus*. From the analysis given above it will be seen that this view is based on a very superficial examination of our plant; and that the structure of the head is entirely analogous to that of the staminate spike of this and the spike of the chlorideous grasses in general, from which the Buffalo-grass can in no manner be separated.

MONANTHOCHLOË, Nov. Gen.

Flores diœci, subconformes.

Spiculæ singulæ, terminales, sessiles, 3–5 floræ, glumis destitutæ.

Planta mascula: flos infimus neuter, e palea inferiore foliacea, sola aut cum palea superiore hyalina integra, emarginata vel bipartita consistens. Flos secundus rarissime unipaleaceus, interdum neuter, plerumque æque ac tertius nec non quartus teres, elongatus, staminiferus. Flos ultimus plerumque abortivus ad stipitem bipaleaceum reductus. Palea floris staminiferi inferior ovato-lanceolata, convoluta, apice scarioso obtusa, sursum virescens, indistincte multi-(9–11) nervis, infra pallida, coriacea, enervis. Palea superior inferiorem paulo excedens, convoluta, apice scarioso obtusa, dorso bicarinata. Squamulæ nullæ. Stamina 3; antheræ lineares utrumque profunde bilobæ, filamentis longiores, vix exsertæ. Ovarii rudimentum nullum.

Planta fœminea: spiculæ masculis simillimæ, flores plerumque 2, rarius 1 aut 3 fertiles. Palea inferior flores superiores basi involvens. Palea superior bialato-carinata, alis circum flores superiores convolutis. [437] Squamulæ nullæ. Stamina 3 rudimentaria minuta. Ovarium lanceolato-lineare, trigonum, basi in stipitem angustatum, apice acutato bifidum glabrum; styli terminales erecti, ovarium æquantes; stigmata stylis duplo longiora, ex floris apice exserta, pilis simplicibus plumosa. Caryopsis libera triangularis.

Gramen littoribus sinus Mexicani Texanis Floridanisque incolum, ramosum, stoloniferum, fruticulosum; foliis brevissimis, rigidis, squarrosis; floribus vix conspicuis. — *Monanthochloë* græce gramen floribus (spiculisve) singulis gaudens.

Monanthochloë littoralis, *n. sp.*

Perennis suffruticosa ramosissima stolonifera glabriuscula; foliis fasciculatis linearibus falcatis brevibus rigidis multinerviis, apice obtusiusculo cartilagineis, supra ad nervos puberulis, margine ciliato-scabris; ligulis abbreviatis truncatis breviter ciliatis; spiculis singulis in apice caulis ramulorumque intra folia superiora sessilibus.

This peculiar and most interesting grass has been sent by *Drummond* from Texas, by *Berlandier* (No. 3227) from the region of Matamoras (mouth of the Rio Grande?) by *Blodgett* from Key West, Florida, and *Lindheimer* found it in flower, in May, on the island of Galveston, Texas, "covering large tracts of moist, sandy, saline soil."* I have

* "*Monanthochloë littoralis*, Engelm., heretofore only known from coasts of the Gulf of Mexico, I found on the Bay of San Diego, Cal., where it grows with that curious *Batis maritima*, already noticed there 30 years ago by Dr. Parry." — *Engelmann*, in Bot. Gazette, 1881, vi. 225. — Eds.

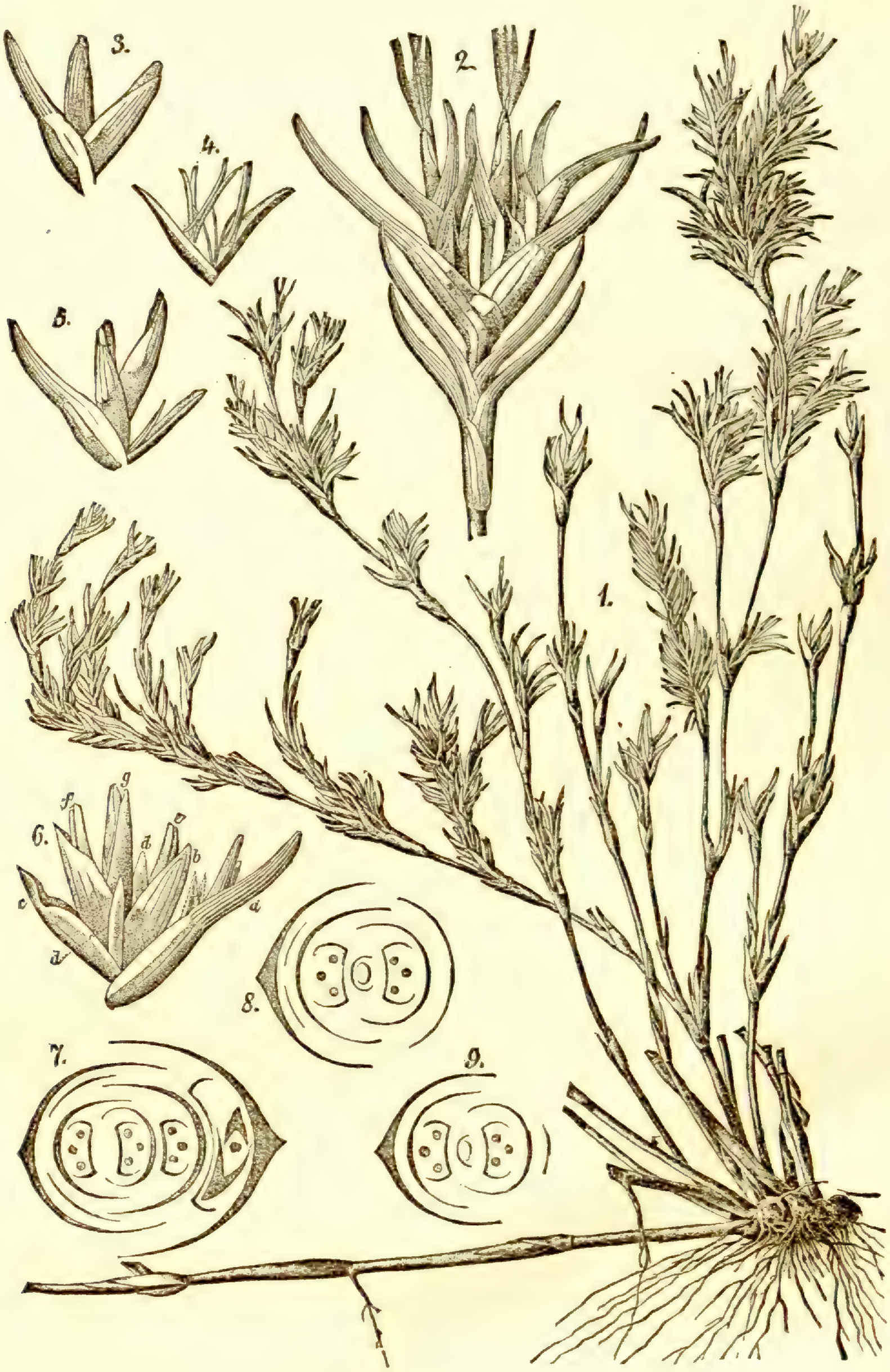


PLATE XIII. — MONANTHOCHLOË LITTORALIS.

been able to examine Berlandier's specimens, female plants in flower, and those of Lindheimer, who collected both sexes, the females more abundantly than the males. The ripe fruit is unknown to me.

Stems 5–8 inches high, much branched, erect or often at last decumbent and rooting; upper branches mostly short, 4–6 lines long.

Leaves short, rarely more than 3 lines long, very rigid, strongly nerved, apparently permanent in winter, mostly crowded at the ends of the stems and branches. The upper leaves all bear axillary buds more or less developed. Spikelets (between 3 and 4 lines long) solitary, terminal, enclosed by the uppermost leaves, which form a complete and uninterrupted transition to the floral envelopes, the uppermost leaf, without the intercession of glumes, representing the lowest palea of the spikelet. This uppermost leaf or lowest palea has a doubtful and intermediate character, and might be taken for one or the other, or for a glume, whenever it is empty; but often it includes an hyaline scale, which cannot be anything else but an upper palea, and therefore characterizes this lowest organ of the spikelet as the lower palea of the lowest always incomplete and neutral flower. It cannot be supposed that a glume is missing or abortive, as we can follow the regular succession of bud-bearing leaves to this lowest floral leaf or [438] palea. The upper palea of this lowest flower, when present, is usually extremely thin and transparent; it is small or large, flat or reflexed, nerveless or (very rarely, like the other upper paleæ) bicarinate;[3] it is entire, lanceolate, or ovate, or emarginate, or bilobed, or sometimes divided into two unequal lanceolate parts, placed side by side, and in some flowers (see Pl. XIII. Fig. 6) laterally protruding from the base of the lower palea and rather oddly placed on both sides of the spikelet.

The second flower is like all the others pedicelled, and is mostly perfect, that is, staminate or pistillate; in a very few instances (see Pl. XIII. Fig. 5, and Pl. XIV. Fig. 20), it was found neutral and either with a somewhat foliaceous lower palea, or with both paleæ smaller than in the other flowers; rarely it is reduced to a single palea, which is herbaceous or membranaceous; in a single instance it was almost entirely suppressed, and the third flower, above and on the same side as the lowest one, appeared to be the second. The rare case where two single, empty paleæ alone are left of the two lowest flowers approaches nearest to the regular structure of grass flowers; these paleæ then assume the place and apparent function of glumes, and the spikelet then resembles that of *Kœleria*, for example, in the arrangement of its parts. The normal variability in the formation of the floral envelopes of this grass thus furnishes an interesting clew to the morphology of these organs. The third flower, usually well developed, is sometimes (oftener in the female than in the male plant) reduced to a mere rudiment.

In female plants I have never seen more than 2 pistillate flowers, and very rarely a rudimentary fourth flower; male plants show often 3 staminiferous flowers, usually with an upper abortive one. The spikelet therefore is destitute of glumes, and consists of 3–5 flowers, of which always the lowest, sometimes the second, and usually the uppermost one, are neutral or rudimentary, and of which 1–3 of the middle ones bear stamens or pistils.

The lower palea of the fully developed flowers is ovate-lanceolate, obtuse at the scarious point, and envelops not only the upper palea but also the base of the upper flowers; it is faintly 9–11-nerved in the upper and indistinctly 3-nerved in the lower half, thus representing, as it would seem, both parts of the leaf, the sheath and the blade; nothing like a ligula, however, can be found.

The upper palea is narrower and a little longer than the lower one, especially in the male flowers, obtuse [439] and scarious at tip, and in the female closely envelops the pistils. In the staminate flower it is bicarinate on the back; in the pistillate flower these keels are developed into wings, which are rolled around the upper flowers, as is indicated in the diagrams. No scales (*lodiculæ*) were seen in either flowers.

Stamens scarcely longer than the paleæ; anthers linear, deeply bilobed at both ends, longer than the filaments. In the pistillate flower 3 minute triangular bodies seem to represent the stamens.

The stipitate ovary is elongated, triangular, with one angle towards the lower, and two towards the keels of the upper palea; it is deeply bifid, the lobes terminating into straight erect styles. Simple hairs of the feathery stigma scarcely dentate.

The systematic position of this grass is certainly a doubtful one, and the opinion which I venture to offer, that its next allies must be looked for among the *Chlorideæ*, a tribe principally distinguished by its one-sided compound spikes, may appear paradoxical. I take it to be the most reduced form of this tribe, where a single and incomplete spikelet only is left of the one-sided spikes. Thus *Monanthochloë* would find its place near the similarly creeping *Cynodon*, and with those other seaside-grasses, the *Spartinæ*.

Happily, to confirm my position, I find in Torrey's lately established genus *Munroa* (Whipple's Botany in Pacif. R. R. Rep. iv. 158), the old *Crypsis squarrosa*, Nutt., an intermediate not quite so much reduced form of a grass. *Munroa* is evidently nearly allied to *Monanthochloë*, but has, instead of one, three spikelets, included between the uppermost leaves, on a *terminal* rhachis; two lateral oblique and one-sided, and the terminal one straight. Prof. Torrey has already noticed the oblique position of the glumes of the lateral spikelets, which, together with the one-sided position on the rhachis, is characteristic of *Chlorideæ*. The terminal spikelet is more regularly formed, as is also

[3] In this case the lower palea also is less leaf-like, and has only a short foliaceous cusp.

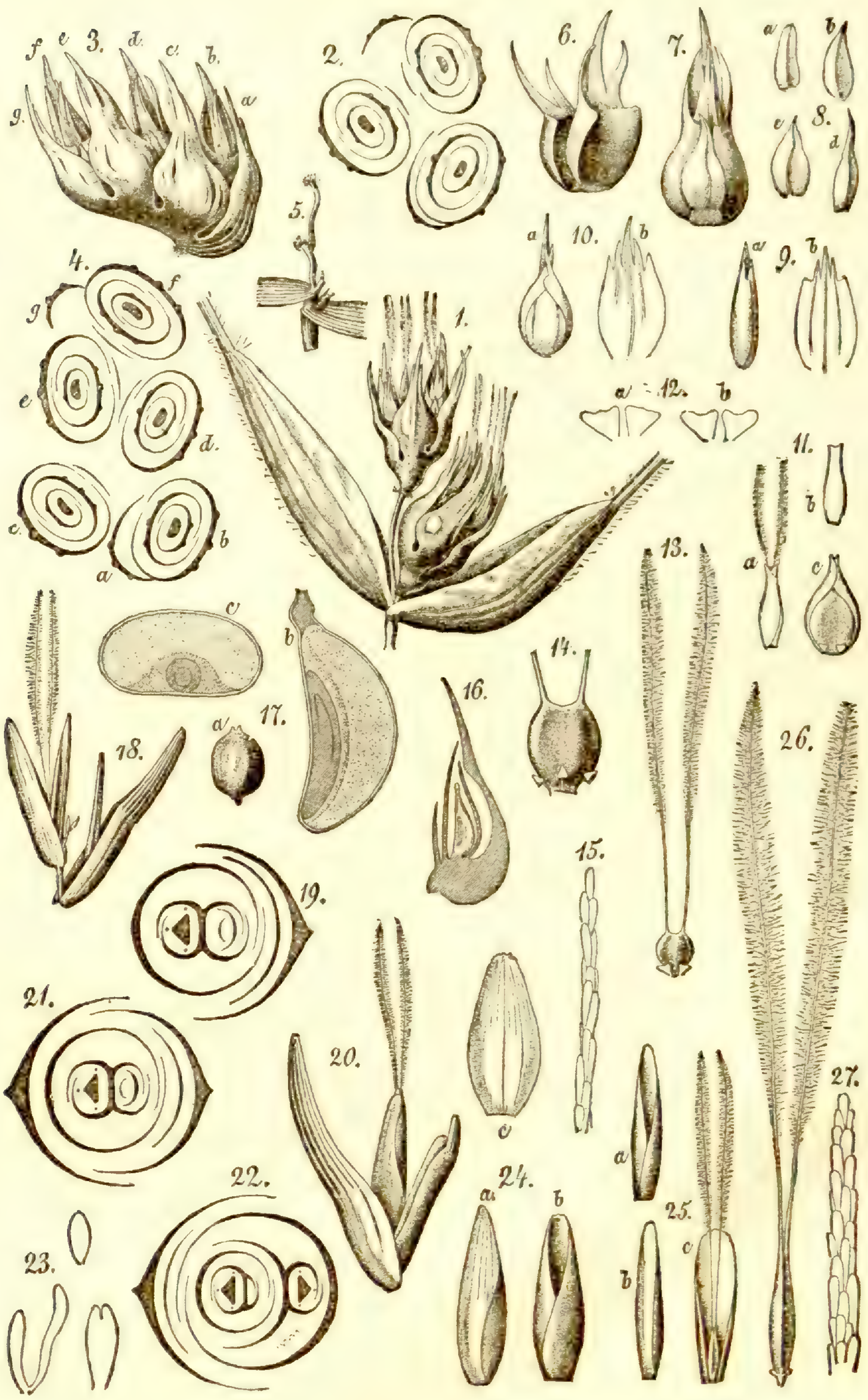


PLATE XIV. — BUCHLOË AND MONANTHOCHLOË.

the terminal spikelet in the staminate spikes of *Buchloë* (see Pl. XIII. Fig. 8). This terminal spikelet, which, from its position, cannot be oblique, is, in *Monanthochloë*, all that is left.

The elongated feathery stigmata, protruding from the apex of the flower, are found in all three of the genera mentioned, as also in *Spartina* and other chlorideous grasses, though not in all of them.

The principal difference of *Monanthochloë* and *Munroa* from *Chlorideæ* proper, consists in their spikelets being terminal or arranged on a terminal rhachis, and not on lateral more or less digitate spikes. If this dif- [440] ference should be deemed too important to let them stand in this alliance, they must be classed with *Sesleriecæ*, a tribe already distinguished by Koch in his German Flora, but since overlooked by the latest writers on grasses, though so well characterized and distinguished from *Festuceæ* by the flowers being arranged in terminal, sometimes one-sided spikes, and by the elongated stigmata protruding from the apex of the flowers.

EXPLANATION OF PLATES.

Buchloë dactyloides.

Plate XII. **Fig. 1.** A female plant with stolons, in fruit.
Fig. 2. A larger and a smaller stalk with male spikes.
Fig. 3. A specimen bearing both male and female flowers. These figures are of natural size; all the others are more or less magnified.
Fig. 4. An unusually short staminate spike in the position of the pistillate spike at Pl. XIV. Fig. 3, and with scarcely more spikelets, to show the analogy of both.
Fig. 5. Diagram of the same.
Fig. 6. A two-flowered spikelet, seen from the inside of the spike, so that the lower glume is exhibited.
Fig. 7. A tri-flowered spikelet.
Fig. 8. Terminal spikelet of a spike, with larger lower glume.
Fig. 9. Flower open, with the stamens.
Fig. 10, *a*, *b*, *c*. Different forms of the lower glume.
Fig. 11, *a*, *b*, *c*. Same of upper glume; *c* shows an upper glume with a secondary nerve, — a rare occurrence, found occasionally in specimens from Fort Kearney.
Fig. 12. Lower palea: *a*, of the lower flower, midrib running out into a point; *b*, of the upper flower, blunt.
Fig. 13. Upper palea: *a*, from the inside and partly folded, showing also the scales; *b*, same, unfolded, also with the scales; *c*, same, from the upper flower, both nerves at point much closer than in the lower flower.

Plate XIV. **Fig. 1.** Two heads in flower, in their natural position; the involucral leaves somewhat opened.
Fig. 2. Diagram of the lower of these heads, *a*; the upper head, *b*, has also 3 fertile flowers, but their arrangement is exactly reversed.
Fig. 3. An elongated head with 5 fertile flowers, showing their arrangement in a one-sided spike; *a*, the lower glume of the lowest spikelet; *b*, lowest spikelet, as well as *d* and *f* on the off side of the rhachis; *c* and *e*, two spikelets alternating with these, on the near side of the rhachis; *g*, last sterile glume, the rudiment of the sixth flower.
Fig. 4. Diagram of same; the letters correspond with those in the last figure. [441]
Fig. 5. Rhachis of 3 spikelets, with the base of 2 involucral leaves, in the axil of the lower one a bud.
Fig. 6. Lower and upper glume of the lowest spikelet of a head in fruit; the upper is attached to the back of the lower glume.
Fig. 7. One of the other spikelets, seen from the inside of the head, exhibiting the lower glume, part of the upper one, and the upper half of the lower palea.
Fig. 8. Different forms of the lower glume: *a*, narrow and obtuse; *d*, foliaceous at the upper half, — a very rare occurrence.
Fig. 9. Lower palea of the flower: *a*, from the inside, rolled up; *b*, outside, unfolded.
Fig. 10. Same of the fruit: *a*, from the inside, folded around the upper palea, both dorsal nerves of which are visible; *b*, same, unfolded.
Fig. 11. Upper palea: *a*, from the inner side, with the stigmata protruding; *b*, same from the back, showing both nerves; *c*, upper palea including the ripe seed, seen from the inside; scales visible.
Fig. 12. Scales: *a*, truncate, *b*, emarginate-bilobed; more magnified.
Fig. 13. Ovary with the styles, more magnified. At the base of the ovary one of the 3 rudimentary stamens and both scales are visible.
Fig. 14. Ovary, still more magnified, with all three rudimentary stamens; scales removed.
Fig. 15. Part of a stigmatic hair, highly magnified.
Fig. 16. Vertical section of a fruit-bearing spikelet, exhibiting both glumes (the outer upper one the longest and much thickened), both paleæ and the grain.
Fig. 17. Grain: *a*, seen from the convex inner side (turned towards the upper palea); *b*, horizontal, and *c*, vertical section of same; *a* and *b* more magnified.

MONANTHOCHLOË LITTORALIS.

Plate XIII. Fig. 1. Female plant in flower; here and there the small spikelets are recognized by the protruding stigmata. Natural size; all the other figures are magnified.

Fig. 2. Top of a stem of the same plant, showing the manner of ramification, the different leaves, the bifid scales which form the lowest leaf of each branch towards the stem, and which correspond to the upper paleæ. The figure shows the lower stem leaves, which have no branches in their axils, with smaller, narrower sheaths, while the upper branch-bearing leaves have large ventricose sheaths.

Fig. 3. Spikelet consisting of the foliaceous lower palea, including a hyaline scale, and two flowers. The plan is the same as in the female flower, Pl. XIV. Fig. 22.

Fig. 4. Single flower, open, showing the stamens.

Fig. 5. Spikelet with first and second flowers neutral, and both upper ones staminate.

Fig. 6. Top of a branch, exhibiting the uppermost leaf, *a*, with an axillary branch, composed of the lowest bifid, *b*, and two regularly formed leaves; the lower palea of the lowest flower, *c*, is less foliaceous than usual; upper palea of same divided in two thin scales, *d*, *d*, lateral to the [442] flowers; three staminate flowers, *e*, *f*, *g*.

Fig. 7. Diagram of same.

Fig. 8. Diagram of a similar spikelet, in which both parts of the upper palea are hidden in the cavity of the lower one; second flower reduced to a single hyaline scale; third and fourth flower staminate; fifth, rudimentary.

Fig. 9. Diagram of another spikelet in which the lowest flower is reduced to a single herbaceous lower palea, the second one to a small membranaceous scale, corresponding to an upper palea; third and fourth flowers staminate, and fifth rudimentary.

Plate XIV. Fig. 18. A very simple female spikelet, laid open; exhibiting a lower flower (consisting of 2 empty paleæ, the lower one herbaceous, the upper membranaceous and revolute), a second pistillate, and a third rudimentary flower.

Fig. 19. Diagram of same.

Fig. 20. Spikelet composed of an empty foliaceous palea representing the lowest flower; an empty second flower, with the lower palea foliaceous at tip, the upper one bilobed; a single pistillate flower, and a rudimentary fourth flower.

Fig. 21. Diagram of same.

Fig. 22. Diagram of a spikelet, in which the lowest flower consists of 2 empty paleæ; the second and third flowers bear pistils. This is the usual form of the pistillate spikelet; the upper palea of the lowest empty flower is often wanting.

Fig. 23. Forms which the upper palea of the lowest flower sometimes assume.

Fig. 24. Lower palea of pistillate flowers: *a*, outside view; *b*, inside view, slightly unfolded; *c*, same, fully unfolded, so as to show the nervation.

Fig. 25. Upper palea of same: *a*, outside view, showing the wings partly rolled in; *b*, inside view; *c*, same, unfolded, exhibiting the ovary and styles.

Fig. 26. Ovary and styles, with the rudimentary stamens at base; more magnified.

Fig. 27. Part of a stigmatic hair, highly magnified.

The principal figures were drawn by Mr. P. Roetter, the analyses by the author.

NOTE. — While this article is going through the press I have an opportunity to examine the true *Antephora* as Steudel, or *Anthephora* as the author, Schreber, writes it. The 4–5-flowered head of spiculæ has certainly a very great resemblance to the female heads of *Buchloë;* there are the same exterior indurated glumes, forming together an involucrum, the same subulate glumes towards the centre of the head, and the paleæ of the fertile flower have the same direction, the lower one towards the centre, and the upper one towards the outside of the head. But the outer involucral leaf is the lower glume (as Kunth, Agrost. i. 169, and Endl. Gen. p. 85, have it; while Steudel, Glum. i. p. 111, calls it less correctly an involucrum), the inner is the upper one; then comes a membranaceous palea constituting the lower sterile flower as in many *Paniceæ*, towards the outside of the head, and towards the inside the fertile chartaceous flower; the analogy, therefore, is a superficial one only; but it is interesting to observe here again, as so often elsewhere, how different organs may assume the same appearance and the same functions. The specimen examined is No. 2538 of Fendler's Venezuela Collection.

The following names for grasses are also to be noted: —

SPARTINA JUNCIFORMIS, *Engelm. & Gray.* Plantæ Lindheimerianæ, part 1 (Boston Journ. Nat. Hist. vol. v. 1845, p. 238, p. 30 of reprint).

ARISTIDA BASIRAMEA, *Engelm. in litt.* Vasey in Bot. Gazette, vol. ix. 1884, pp. 76, 77. — EDS.

XIII.

LISTS AND COLLECTED DESCRIPTIONS OF PLANTS.*

I. CATALOGUE OF A COLLECTION OF PLANTS MADE IN ILLINOIS AND MISSOURI, BY CHARLES A. GEYER; WITH CRITICAL REMARKS, ETC.

From the American Journal of Science, Vol. XLVI. 1843.

Mr. Geyer, who is an excellent collector, is now absent on an expedition to the Rocky [94] Mountains and Oregon, as announced in the last volume of this Journal (p. 226). Being unwilling to adopt the common plan of selling his collections to subscribers before they are actually made, he prefers to seek some needful aid in the prosecution of his arduous undertaking, by offering to the botanical public sets of the following plants, collected in 1842 near St. Louis, Missouri, and around Beardstown on the Illinois River. This collection (which is duly mentioned on p. 227 of Vol. XLV.) consists of the following species: —

1. Ranunculus micranthus, *Nutt.* Apparently common in the grassy river bottoms, and on fertile grassy hills in Missouri and Illinois. It is very near *R. abortivus*, but apparently well distinguished by its pubescence, and the more orbicular, very seldom cordate or reniform lowest leaves. 2. R. fascicularis, *Muhl.* 3. Myosurus minimus, *Linn.* Certainly a native plant.[1] 4. Isopyrum biternatum, *Torr. & Gr.* 5. Delphinium tricorne, [95] *Michx.* 6. Trautvetteria palmata, *Fisch. & Mey.*; an entirely new locality for this rare plant, which has heretofore been found only in the Alleghany and Rocky Mountains. 7. Thalictrum anemonoides, *Michx.* 8. Brasenia peltata, *Pursh.* 9. Corydalis aurea, *Willd.*; the smaller, glaucous variety of the banks of the western rivers. 10. Cardamine Ludoviciana, *Hook.* 11. C. hirsuta, *Linn.* β. Virginica. 12. Sisymbrium canescens, *Nutt.* 13. Draba brachycarpa, *Nutt.* 14. D. Caroliniana, *Walt.* 15. Lepidium Virginicum, *Linn.* 16. Polygala purpurea, *Nutt.* 17. P. incarnata, *Linn.* 18. P. verticillata, *Linn.*

19. Viola pedata, *Linn.* 20. V. delphinifolia, *Nutt.*; common in rich prairie soil in Illinois and Missouri,

* Arranged chronologically as far as practicable. — Eds.

[1] We now ought to be careful observers of such plants as are apparently common to both continents; in after years it will be much more difficult to decide which are natives and which introduced. Many European plants, now common weeds east of the Alleghany Mountains, have not yet found their way to the Mississippi valley, but undoubtedly will arrive in a short time. Other plants are here already as common as they are in Europe, from whence they were derived, or in middle Asia, perhaps their original home. It behooves us therefore to note the progress of these intruders, and distinguish from them the true natives.

We are able to distinguish several different classes of such plants: —

1. *Nearly allied geographical species*, where one takes the place of the other in the other continent; such as *Quercus alba* in North America, and *Q. pedunculata* in Europe; *Carpinus Americana* and *C. Betulus*; *Polygonum Persoonii*, n. sp. (*P. mite*, Pers.) and *P. mite*, Schrank; *Androsace occidentalis* and *A. elongata*; *Lycopus sinuatus* and *L. Europæus*, and many others.

2. *Geographical varieties*, where no specific distinction can be discovered between the natives of both continents, but where the American and European variety can always be distinguished by some points of minor importance. Such are *Sium latifolium*, *Circæa lutetiana*, *Samolus Valerandi* (if it does not belong to the first class), *Castanea vesca*, *Lepidium ruderale*, *Astragalus hypoglottis*, *Eriophorum gracile*, *Myosurus minimus*, etc.

3. *Identical plants*, true natives of both continents, especially arctic or at least northern plants; also marine species and cryptogamic plants; e. g. *Potentilla anserina*, *Campanula rotundifolia*, *Epilobium spicatum*, *Cornus Suecica*, *Phragmites communis*, *Salicornia herbacea*, *Glaux maritima*, most *Equiseta*, etc.

4. *Naturalized plants*, spreading with the progress of civilization; of these we have in the neighborhood of St. Louis, *Taraxacum Dens-Leonis*, *Marrubium vulgare*, *Trifolium repens*, *Bromus secalinus*, *Verbascum Thapsus*, and *V. Blattaria* (perhaps belonging to the third class), *Nepeta Cataria*, *Arctium minus*, etc. *Cichorium Intybus*, *Echium vulgare*, and others, I have not seen in the West.

It is difficult to decide to which of these classes *Datura Stramonium* and *Portulaca oleracea* should be referred. *Datura* is perhaps introduced in Europe as well as America, and possibly did not reach this country from Europe. *Erigeron Canadense* and *Œnothera biennis* are now as widely naturalized in Europe, as *Taraxacum* is in America.

where it does not take the place of *V. pedata*, as Nuttall intimates, but grows in the same region, though never on such poor clayey or gravelly soil as *V. pedata*. 21. V. PALMATA, *Linn.*, and 22. V. SORORIA, *Willd.*, are certainly nothing but varieties of *V. cucullata*, Ait. 23. V. SAGITTATA, *Ait.* 24. V. STRIATA, *Ait.* 25. PARNASSIA CAROLINIANA, *Michx.* 26. HYPERICUM SPHÆROCARPUM, *Michx.* 27. H. SAROTHRA, *Michx.*

28. ANYCHIA CAPILLACEA, *Nutt.*; well distinguished from *A. dichotoma*, Michx., by the smooth stem, the ovate or oblanceolate obtuse leaves of the branches, the pedunculate flowers, 1-nerved obtuse sepals, and twice as large seeds. 29. LINUM RIGIDUM, *Pursh.* 30. MALVA HOUGHTONII, *Torr. & Gr.* Intermediate between *Malva* and [96] *Sphæralcea*, the carpels being 1-seeded as in *Malva*, but 2-valved as in *Sphæralcea*. The carpels separate mostly from the receptacle and from one another before opening. 31. PSORALEA FLORIBUNDA, *Nutt.* 32. AMORPHA CANESCENS, *Nutt.* 33. PETALOSTEMON VIOLACEUM, *Michx.*

34. ASTRAGALUS TRICHOCALYX, *Nutt.?* Probably a different species, but as I am unable to compare original specimens of Nuttall's plant, I am at present unable to decide. This species grows from a very strong fusiform ligneous root, in many cespitose stems, in the rich prairies and on grassy hills near St. Louis (in Illinois), and through the whole State of Missouri. It flowers in April and the beginning of May. The corolla is ochroleucous, with a bluish tip to the carina; the unripe legumes are succulent and edible, and when boiled, resemble young beans in taste.

35. DESMODIUM SESSILIFOLIUM, *Torr. & Gr.* 36. LESPEDEZA CAPITATA, *Michx.* 37. CROTALARIA SAGITTALIS, *Linn.* 38. SPIRÆA LOBATA, *Murr.*, and 39. SANGUISORBA CANADENSIS, *Linn.* New localities for these plants, and probably the southern limit for them in the Mississippi valley. 40. CRATÆGUS COCCINEA, *Linn.* var.? MOLLIS, *Torr. & Gr.* 41. C. TOMENTOSA, *Linn.* 42. RHEXIA VIRGINICA, *Linn.*

43. CALLITRICHE VERNALIS, *Kützing in Linnæa*, vii. 178. One of the species of this genus common to America and Europe, and by most authors confounded with several others under the name of *C. verna*, Linn. It is well distinguished by the four angles of the small fruit being carinate; most other species having broadly winged angles and larger fruits.

44. CICUTA MACULATA, *Linn.* 45. THASPIUM CORDATUM, *Torr. & Gr.* 46. GALIUM PILOSUM, *Ait.* 47. SPERMACOCE GLABRA, *Michx.* 48. DIODIA TERES, *Walt.* 49. HEDYOTIS MINIMA, *Torr. & Gr.* 50. H. PURPUREA, var., *Torr. & Gr.* 51. LIATRIS CYLINDRACEA, *Michx.* 52. L. PYCNOSTACHYA, *Michx.* 53. ASTER SERICEUS, *Vent.* 54. A. TURBINELLUS, *Lindl.* 55. A. AZUREUS, *Lindl.* 56. A. SAGITTIFOLIUS, *Willd.* 57. A. MULTIFLORUS, *Ait.* 58. [97] A. DUMOSUS, *Linn.?* 59. A. MISER, *Linn.* γ. DIFFUSUS, *Torr. & Gr.* 60. A. SIMPLEX, *Willd.* 61. A. CARNEUS, *Nees.* 62. A. PUNICEUS, *Linn.* β. FIRMUS, *Nees.* 63. A. OBLONGIFOLIUS, *Nutt.* 64. DIPLOPAPPUS LINARIIFOLIUS, *Hook.* 65. D. UMBELLATUS, *Torr. & Gr.* 66. SOLIDAGO SPECIOSA, *Nutt.* 67. CHRYSOPSIS VILLOSA, *Nutt.* 68. SILPHIUM INTEGRIFOLIUM, *Michx.* 69. ECHINACEA ANG STIFOLIA, *DC.* 70. HELIANTHUS OCCIDENTALIS, *Ridd.* 71. H. DORONICOIDES, *Lam.* 72. H. HIRSUTUS, *Raf.* 73. ARTEMISIA CAUDATA, *Michx.*

73 *b*. MATRICARIA DISCOIDEA, *DC.* I have no doubt of this plant being a native here, and not introduced from Oregon or California, as Torrey and Gray (*Flora*, ii. 413) suggest. It grows not only on wastes and roadsides near and even in St. Louis — (here it is found with *Maruta Cotula*, but flowers before this is six inches above ground) — but also four or five miles from the town, on grassy spots in the woods. 74. HIERACIUM GRONOVII, *Linn.* 75. LOBELIA LEPTOSTACHYA, *A. DC.* 76. CAMPANULA APARINOIDES, *Pursh.* 77. SPECULARIA PERFOLIATA, *A. DC.* 78. ASCLEPIAS VERTICILLATA, *Linn.* 79. A. INCARNATA, *Linn.* 80. GENTIANA RUBRICAULIS, *Keat.* 81. G. OCHROLEUCA, *Willd.* 82. PHLOX GLABERRIMA, *Linn.*

83. CUSCUTA VULGIVAGA, *Engelm. in Sill. Journ.* xliii. 338. *C. Gronovii*, Choisy. *C. Americana*, Auctor. 84. C. CEPHALANTHI, *Engelm.* Well distinguished by its small cylindric flowers, and by the corolla remaining on top of the capsule. It is found more on *Vernonia fasciculata* than on *Cephalanthus*. So far only found near St. Louis. 85. LEPIDANCHE COMPOSITARUM, *Engelm.* So far only found in the prairies of Indiana, Illinois, and Missouri. *Cuscuta glomerata*, Choisy.

86. MYOSOTIS VERNA, *Nutt.?* If the description of *Myosotis verna* given in some American floras is correct, our plant cannot be the true *verna*. But as I have neither seen Nuttall's character, nor original specimens, nor eastern specimens at all, I must leave this undecided. If our plant should prove distinct, I would suggest the name [98] *M. inflexa*, adopted by me long since. I add the distinguishing characters of the European, the Western, and a nearly related Texan species.

M. STRICTA, *Link:* calycibus profunde 5-fidis, laciniis subæqualibus linearibus obtusiusculis; calyce fructifero clauso; racemis basi foliatis; pedicellis fructiferis calyce brevioribus; tubo corollæ incluso; nucibus minimis. — *M. arvensis*, Reichenb., non Link, Lehm., Ehrh. Europe. — Nuts grayish-olive, very small, equal in size to the black nuts of *M. versicolor*.

M. INFLEXA, *n. sp.*: calycibus 5-fidis, laciniis calycis fructiferi erecto-conniventibus inæqualibus 2 inferioribus longioribus omnibus lanceolatis acutis albo-hispidis; racemis basi foliatis; pedicellis fructiferis calyce subbrevioribus basi erectis adpressis medio inflexis horizontalibus; tubo corollæ incluso; nucibus mediis *M. verna*, Nutt.? Missouri and Illinois, dry prairies, open woods. April and May. — Annual or biennial? Calyx bilabiate; nuts twice as large as in the foregoing, of same color, equal in size to the black nuts of *M. intermedia*, Link.

M. MACROSPERMA, *n. sp.* : calycibus 5-fidis, laciniis calycis fructiferi ovatis triangularibus acutis 2 inferioribus 3 superiores duplo superantibus, omnibus erecto-conniventibus flavo- s. ferrugineo-hispidissimis ; racemis basi subfoliatis ; pedicellis fructiferis calyce brevioribus basi adpressis ; calycibus horizontalibus ; tubo corollæ denique calyce longiore ; nucibus maximis. Texas, prairies, April. *F. Lindheimer.* — Nuts of same color as both others, but twice as large as those of the last, and larger than those of any European species examined by me ; uncinate hairs of the calyx very long, stiff, spreading in all directions ; flowers not so crowded as in both the foregoing species.

87. PHACELIA PURSHII, *Buckley, in Sill. Journ.* XLV. 171. 88. PHYSALIS PENNSYLVANICA, *Linn.* Some of the specimens have smooth, and others pubescent or hairy calyces ; these last ones constitute the *P. lanceolata*, Michx. 89. PENTSTEMON PUBESCENS, *Linn.* 90. COLLINSIA VERNA, *Nutt.* 91. GRATIOLA AUREA, *Muhl.* ? 92. HEDEOMA PULEGIOIDES, *Pers.* 93. H. HISPIDA, *Pursh.* 94. PYCNANTHEMUM PILOSUM, *Nutt.* 95. MONARDA PUNCTATA, [99] *Linn.* 96. DRACOCEPHALON VIRGINIANUM, *Linn.* 97. SCUTELLARIA GALERICULATA, *Linn.*

98. VERBENA PANICULATA, *Lam.* With undivided leaves, the true *V. paniculata ;* and with the lower leaves divided, lobed or hastate, *V. hastata*, Linn., which can hardly be called even a variety. As Lamarck's name is equally applicable to both forms, it probably ought to be preferred to the Linnæan name.

99 to 102. Four hybrids of different species of Verbena, which together with several others that abound in this neighborhood, Mr. Geyer appears to have found equally abundant on the sandy wastes near Beardstown, and on the sandy islands of the Illinois River.

The names, chosen according to Schiede's proposition, indicate the parent plants ; but it is often difficult enough to detect the parentage ; indeed, to ascertain which is the male and which the female parent is probably quite impossible if actual experiments be not instituted. Generally both parents grow near the hybrid, but as these Verbenæ are perennial, the hybrids, being unable to produce seed, propagate the more readily by stolons, and spread in some localities so as even to exceed one or the other of the parents in number. In such cases we have to rely entirely on the resemblance of the offspring to some true species in the vicinity. All these hybrids, however, are known to be such by their luxuriant growth exceeding that of their parents, by their sterility, and mostly by their local appearance in places where their parents are common. We find, as is naturally to be expected, many hybrids which resemble one of their parents more than the other ; and hence many intermediate hybrid forms may be observed, so as to furnish all the connecting links between two very distinct species ; this of course not proving the identity of such species, but rather the reverse. No hybrids are more common here than those between *V. stricta*, Vent. and *V. urticæfolia*, Linn., and I possess specimens not only of *V. urticæfolio-stricta* (near *V. stricta*), and of *V. stricto-urticæfolia* (near *V. urticæfolia*), but of several intermediate forms, the extremes of which might be taken for mere varieties of *V. stricta* and of *V. urticæfolia ;* or they may be produced by seeds from these plants, adulterated by some pollen from the other species. The difficulty is increased by the fact that these doubtful hybrids produce more seeds than the [100] nearly intermediate hybrids, though far less than the true species. In the course of time, if they propagate at all, they may revert again to their parental species, especially if the very probable supposition be true, that, when the ovary of these hybrids is fertile, the pollen is inert.*

99. V. PANICULATO-STRICTA : more hirsute than *V. paniculata*, but not canescent like *V. stricta ;* leaves much narrower than in *V. stricta*, subsessile or decurrent in a short petiole, simply or doubly or incisely serrate ; spikes more crowded than in *V. paniculata*, more fascicled, not paniculate ; calyces hairy, somewhat gray, longer than in *V. paniculata ;* corolla intermediate in size and color, much paler than in *V. paniculata ;* style persistent for some time on the ripening fruit, as in *V. paniculata*. Grows in abundance on the sandy, sometimes overflowed, banks of the Mississippi, opposite St. Louis, with other hybrid forms, and with *V. stricta*, *V. urticæfolia*, and *V. bracteosa*. *V. paniculata* is very rare there, perhaps destroyed by the growing bushes, which now cover the formerly grassy spots. Nevertheless, the narrow leaves, deeper colored flowers, and persistent style prove sufficiently that *V. paniculata* is one of its parents. Flowers in July and August.

100. V. URTICÆFOLIO-BRACTEOSA : decumbent like *V. bracteosa*, but large, spreading sometimes two or three feet; leaves small, like *V. bracteosa*, laciniate ; spikes fascicled, filiform ; flowers distinct, as in *V. urticæfolia ;* bracts longer than the calyx, but not more than half as large as in *V. bracteosa ;* corolla larger than in *V. urticæfolia*, with a longer tube, very pale purple. The parents of this hybrid cannot be mistaken ; the growth, the leaves, the bracts are of one, the spikes, and the smaller size and paler color of the corolla of the other. On sand-bars and sandy islands in the Mississippi (St. Louis) and Illinois Rivers (Beardstown). Flowers July to September.

101. V. STRICTO-URTICÆFOLIA : an interesting hybrid between two very distinct species. The plant is more canescent than *V. urticæfolia ;* the leaves shorter petioled, sometimes nearly sessile, of firmer texture, and not simply serrate, but generally doubly or even incisely serrate ; sometimes even so much incised or lobed that I would have been inclined to look to *V. hastata* or *V. bracteosa* for an explanation, but we cannot admit the action of three

* For further remarks on this subject see Transactions of the St. Louis Academy of Science, vol. i., Journal of Proceedings, Sept. 5, 1859, pp. 675, 676 ; and Botany of the Upper Missouri (Hayden, in Transactions of the American Philosophical Society, 1862, n. s. vol. xii. p. 202). — EDS.

species in the formation of hybrids. The spikes are filiform, the flowers compacter than in *V. urticæfolia*, but [101] not as densely imbricated as in *V. stricta* or *V. paniculata;* the calyx much longer than in *V. urticæfolia*, canescently hairy; corolla large, intermediate in size between both parents, and pale purple. This is the most abundant hybrid here, and both parents are amongst the most common weeds about St. Louis. Flowers in July and August.

102. V. URTICÆFOLIO-PANICULATA: leaves petioled, lanceolate, with simple, double, or sometimes incised serratures, generally elongated; spikes thin, more properly filiform than in any of our species; calyx and corolla intermediate in shape, size, and color, between both parents. It resembles some varieties of the true *V. paniculata*, but the dark purple flowers and the thick cylindric fruiting spikes at once distinguish it. St. Louis and Beardstown; grassy places and open woods. July and August.

Besides these four hybrids, I have found here the corresponding ones more nearly resembling the other parent, which I designate by the same names, reversing the order, viz.: —

V. STRICTO-PANICULATA: greener, narrower, more petioled leaves, darker flowers, than *V. paniculato-stricta*.

V. BRACTEOSO-URTICÆFOLIA: adscendent, with large lobed leaves, and thinner spikes.

V. URTICÆFOLIO-STRICTA: canescent, with sessile leaves, and thin filiform spikes.

V. PANICULATO-URTICÆFOLIA: with broader leaves, thinner spikes, paler and smaller flowers.

Then there is the *V. angustifolio-stricta* and *V. stricto-angustifolia*. Hybrids of *V. angustifolia* with any but *V. stricta*, and of *V. bracteosa* with any but *V. urticæfolia*, or of *V. Aubletia*, the only remaining species in this region, I have not yet found. The only other hybrid found by me in this country is *Rumex obtusifolio-crispus*. Whether these introduced plants hybridize in their native country is unknown to me.

103. ANDROSACE OCCIDENTALIS, *Pursh*. 104. LYSIMACHIA REVOLUTA, *Nutt*. 105. PLANTAGO CORDATA, *Lam*. 106. POLYGONUM TENUE, *Michx*. 107. P. SAGITTATUM, *Linn*. 108. CROTON GLANDULOSUS, *Linn*. 109. BORYA LIGUSTRINA, *Willd*. 110. QUERCUS NIGRA, *Willd*. 111. Q. ALBA, *Linn*. 112. Q. CASTANEA, *Muhl*. 113. SALIX [102] MUHLENBERGIANA, *Willd*. 114. S. NIGRA, *Marsh*. 115. S. LONGIFOLIA, *Muhl*. 116. S. RIGIDA, *Muhl*. ?

117. POTAMOGETON DIVERSIFOLIUS, *Barton*, β. SPICATUS. This form appears at first view to be a distinct species, characterized by the narrower, only 5-nerved upper leaves, and petioled oval or cylindric spikes. *P. diversifolius*, α. *capitatus*, the common form, has more oval 7-nerved upper leaves, and nearly sessile few-flowered heads. But sometimes the lower heads of our variety are also capitate and nearly sessile, and the fruit is generally alike. The fruit, or nut, is always compressed, winged on the back, with two lateral carinæ, which are generally denticulate, the nut appearing muricate; and in β. they are often nearly or entirely undivided, but by no means generally so. The embryo describes $1\frac{1}{2}$ spiral circumvolution; the embryo of most other species forms only $\frac{3}{4}$, 1, or $1\frac{1}{4}$ circumvolution. I know but one species, *P. densus*, which exhibits $2\frac{1}{2}$ circumvolutions.

It may not be amiss here to remind botanists in this country, that the ripe fruit furnishes the best characteristic marks to distinguish the different species of *Potamogeton*. The fruit, for example, proves that *P. marinus*, Linn., is entirely distinct from *P. pectinatus*, Linn., with which most authors confound it: *P. marinus* occurs not only on the sea-coast, but also in the salt-ponds of the Upper Missouri (*Geyer*, in Nicollet's Expedition). Specimens of *Potamogeton* should always be collected with ripe fruit.

118. PHALANGIUM ESCULENTUM, *Nutt*. 119. TRILLIUM RECURVATUM, *Beck*. 120. JUNCUS MARGINATUS, *Rostk*. 121. DULICHIUM SPATHACEUM, *Pers*. 122. CYPERUS KYLLINGÆOIDES, *Vahl*. 123. ISOLEPIS CAPILLARIS, *Röm. & Schult*. 124. HELEOCHARIS TENUIS, *Schult*.

125. ERIOPHORUM GRACILE, *Koch, in Roth. Catalect*. 2, p. 259. A species which has frequently been found in the United States; it appears to have been taken for *E. angustifolium* — my specimens at least, received from Pennsylvania and from Ohio, were so labelled — but is easily distinguished by its triquetrous, subulate leaves, and the linear yellowish seeds. The true *E. angustifolium*, Roth., is the largest of all the species, with the longest ($1\frac{1}{2}$ inch) wool; leaves 1 or $1\frac{1}{2}$ lines broad, channelled; peduncles smooth; *E. latifolium*, Hoppe (*E. polystachyum*, [103] Auct.), has flat leaves and scabrous peduncles; and both have obovate, dark or light brown seeds.

I propose the following disposition of these species, acknowledging, however, that I have studied the American varieties from dried specimens only, never having observed any living ones: —

E. LATIFOLIUM, *Hoppe:* culmo trigono, foliis planis apice triquetris, spiculis plurimis, pedunculis scabris, nucibus obovatis. *E. polystachyum*, β., Linn.

α. NIGRO-CARINATUM: squamis floriferis plumbeis, carina nigricante, nucibus acutiusculis brunneis. Germany; probably throughout Europe.

β. VIRIDI-CARINATUM: squamis floriferis obscuris, carina virescente, nucibus obtusis, lutescentibus. Massachusetts, Ohio.

E. ANGUSTIFOLIUM, *Roth.*: culmo teretiusculo, foliis canaliculatis apice triquetris, spiculis pluribus, pedunculis lævibus, nucibus oblanceolatis acutis. *E. polystachyum*, α., Linn. Squamæ floriferæ nigro-carinatæ, albo-marginatæ. Europe. I have not seen any American specimens.

E. GRACILE, *Koch:* culmo obsolete trigono, foliis triquetris, spiculis pluribus, pedunculis scabris, nucibus linearibus (flavicantibus). *E. polystachyum*, γ., Linn. *E. triquetrum*, Hoppe.

a. PLURINERVIUM: pedunculis tomentoso-scabris, squamis floriferis pallidis, nervis pluribus pallidioribus striatis, nucibus obtusiusculis. Germany.

β. PAUCINERVIUM: pedunculis scabris, squamis floriferis pallidis, nervis paucis (3) pallidioribus notatis, nucibus acutis. Illinois, Ohio, Pennsylvania.

126. CAREX ROSEA, *Schk.* 127. C. MULTIFLORA, *Muhl.* 128. C. ARIDA, *Torr. & Schw.* 129. C. CRISTATA, *Torr. & Schw.* 130. C. WILLDENOVII, *Shck.* 131. C. TORREYANA, *Dew.* 132. C. SHORTII, *Torr.* 133. C. LAXIFLORA, *Lam.?* 134. C. MEADII, *Dew. in Sill. Journ.* vol. xliii. p. 90. 135. C. UMBELLATA, *Schk.* 136. PANICUM VIRGATUM, *Linn.* 137. P. PUBESCENS, *Lam.* 138. P. SCOPARIUM, *Lam.* 139. P. CLANDESTINUM, *Linn.* 140. DIGITARIA FILIFORMIS, *Ell.*, var. FLORIBUS MAJORIBUS. 141. ARISTIDA STRICTA, *Michx.* 142. MELICA SPECIOSA, *Muhl.?* 143. FESTUCA NUTANS, *Willd.* 144. DIARRHENA AMERICANA, *Pal. de Beauv.*

145. ATHEROPOGON APLUDOIDES, *Muhl.* 146. A. PAPILLOSUS, *n. sp.*: culmis cæspitosis basi foliatis; foliis [104] lanceolato-linearibus planis margine et ad nervum medianum infra supraque ex papillis serrato-ciliatis; spicis 1–3 subterminalibus biserialibus unilateralibus multifloris; glumis papilloso-hispidis; valva corollæ perfectæ exteriore trifida, valva corollæ neutrius brevissima hyalina ex basi triaristata.

Sandy soil, Beardstown, Ill. — Very near *A. oligostachyus*, Nutt., and resembling it closely, but distinct by the broader and hispid (not setaceous and smooth) leaves, the hispid (not pubescent) glumes, and the hyaline glume of the abortive floret (not half as large as in *A. oligostachyus*).

147. ANDROPOGON SCOPARIUS, *Michx.* 148. POA HIRSUTA, *Michx.* 149. P. PECTINACEA, *Michx.?* 149 *b.* HORDEUM PUSILLUM, *Nutt.* 150. WOODSIA PERRINIANA, *Hook.*

II. DESCRIPTIONS OF NEW SPECIES IN ENGELMANN AND GRAY'S PLANTÆ LINDHEIMERIANÆ.*

FROM THE BOSTON JOURNAL OF NATURAL HISTORY, VOL. V. pp. 210–264 (pp. 2–56 OF REPRINT), 1845; VOL. VI. pp. 141–240, 1850.

PART I. 1845.

1. RANUNCULUS TEXENSIS, *Engelm.*: caule erecto ramosissimo basi hispido; foliis petiolatis, inferioribus [2] ovatis subcordatis denticulatis, superioribus lineari-lanceolatis, basi petiolorum membranaceo-dilatata bracteisque ciliatis; petalis 5 oblongis sepala ovata obtusa longe superantibus; staminibus plurimis; carpellis subglobosis acutis minutim tuberculosis in capitulum globosum congestis. — Margin of ponds, &c., near Houston, April. A [3] span to a foot high, with conspicuous bright yellow petals.

2. R. TRACHYSPERMUS, *Engelm.*: caule ramoso glabro; foliis petiolatis, inferioribus plerumque orbiculato-ovatis obtusis subintegris, superioribus lanceolatis lineari-lanceolatisve denticulatis, basi petiolorum membranaceo-dilatata bracteisque subciliatis; sepalis 3–4 ovatis reflexis petala 3–5 minima lineari-spathulata superantibus; staminibus 5–10; carpellis compressis obtusis undique tuberculosis in capitulum oblongum seu cylindricum congestis. Margin of ponds near Houston, &c., April, May.

3. R. TRACHYSPERMUS, *β.* ANGUSTIFOLIUS, *Engelm. mss.*: foliis omnibus lanceolatis lineari-lanceolatisve; and *γ.*? (an spec.?) LINDHEIMERI, *Engelm. mss.*: foliis inferioribus ovatis; sepalis 3–5 ovatis obtusis patentibus petala 3 lineari-spathulata æquantibus; carpellis compressis obtusiusculis tuberculosis in capitulum globosum congestis. — Near Houston, &c., but not growing together with No. 2.

KRAMERIA. Professor A. Braun, after examining the flowers of species of this genus, has suggested that [4] the natural affinity of *Krameria* is with *Leguminosæ*, rather than *Polygalaceæ*. And, indeed, at least in *K. lanceolata*, the two lateral glandulous petals *cover* in æstivation the stamens; they cannot therefore belong to an interior circle, as Bentham supposes. The ovary is one-carpellary (against the type of *Polygalaceæ*) and irregularly one-sided, like the ovary of *Leguminosæ;* it is imperfectly bilocular, by the inflection of the placenta, as in some *Leguminosæ;* but in both cases the cells are always side by side; on the contrary, in *Polygalaceæ* one is before the other. *Krameria* may, then, be considered a pentandrous *Leguminosa*, where one or two stamina are abortive. In *K. lanceolata*, it is the lowest stamen, opposite the three connected petals, which is wanting; but, in some flowers, a sterile filament occupies this place; it corresponds with the free 10th stamen of most papilionaceous flowers, as the four others, which

* An account of the region in which Lindheimer collected, contributed by Dr. Engelmann to Part II. pp. 234–240, is omitted as of little botanical interest. Besides the species here redescribed, the paper contains a number for which the authors are jointly responsible; the descriptions of these being by Gray, they are indicated by name only. As in the remainder of this part of the reprint, new *Cactaceæ*, *Cuscutæ*, *Euphorbiaceæ*, *Alismaceæ*, *Gramineæ*, *Asclepiadeæ*, and *Loranthaceæ* are omitted, the descriptions referring to these orders having been brought together elsewhere. — EDS.

are united in *K. lanceolata*, are analogous to the tube of nine connected filaments. The lateral sessile petals correspond with the carina, and the three others, whose claws are connected, with the alæ and carina; the five sepals alternate with them, as the stamens alternate with the petals. The fruit resembles somewhat the indehiscent spiny legume of an *Onobrychis;* and, in all the specimens we have examined, it is one-seeded when ripe.

17. HYPERICUM GYMNANTHUM [4]. 24. SIDA LINDHEIMERI [5]. 52. *Lythrum foliosum*, Engelm. mss. (L. alatum, γ. *Torr. & Gr.*) [8]. 58. LUDWIGIA LINEARIS, var. PUBERULA [9]. 61. GAURA LINDHEIMERI [9]. 63. CYNOSCIADIUM PINNATUM, *DC.* β. PUMILUM [10]. 72. LIATRIS ACIDOTA (*L. mucronata*, TORR. & GR.) [10], and 73. β. VERNALIS [11]. 97. HELIANTHUS PRÆCOX [13]. 111. *Egletes Texana*, Engelm. mss. (E. Arkansana, *Nutt.*) [14]. 134. EUTOCA HIRSUTA. (*Phacelia hirsuta*, Nutt.) [18]. 135. SOLANUM TEXENSE [19]. 141. GERARDIA SPICIFLORA, *Engelm. mss.* [19, — not described]. 144. SCUTELLARIA CARDIOPHYLLA [19]. 151. MONARDA LINDHEIMERI [20]. 157. DIPTERACANTHUS NUDIFLORUS [21]. 167. ERIOGONUM LONGIFOLIUM, *Nutt., Benth.* β. PLANTAGINEUM [22]. 168. POLYGONELLA ERICOIDES. (*Gonopyrum Americanum*, Fisch. & Meyer) [22]. 185. *Xyris scabra*, Engelm. mss. (X. Caroliniana, *Walt.*, β. ? scabra) [27]. 187. HYPOXIS ERECTA, β. ÆSTIVALIS. 188. *H. leptocarpa*, Engelm. mss. (H. ERECTA, γ. LEPTOCARPA) [27].

EUSTYLIS. Perigonium hexaphyllo-partitum, conforme, patens; tubo nullo; segmentis obovatis planis, [28] tribus interioribus modice minoribus. Filamenta distincta, e basi lato subulata, antheras subpanduriformes post anthesin immutatas æquantia: connectivum latum basi apicemque versus præsertim dilatatum, loculis marginalibus. Stylus elongatus (stamina adæquans), ad apicem infundibuliformis, trifidus; lobis bifidus, partitionibus in stigmata filiformia recurvia attenuatis. Habitus, bulbus, capsula, etc., omnino Nemostylis. 189. E. PURPUREA. (*Nemostylis? purpurea*, Herbert) [27].

190. GYMNADENIA NIVEA. (*Orchis nivea*, Nutt.) [28]. 191. SPIRANTHES VERNALIS [28]. 198. SCILLA (KAMASSA) ANGUSTA [29]. 217. VESICARIA AURICULATA [32]. 237. PRUNUS GRACILIS [35]. 239. *Gaura exaltata*, Engelm. mss. (G. longiflora, *Spach*) [36]. 261. HELIANTHUS MAXIMILIANI, β. ASPERRIMUS [41]. 268. SENECIO AMPULLACEUS, Hook. var. α. GLABERRIMUS, and 269 var. β. FLOCCOSUS [42]. CONVOLVULUS LOBATUS [44]. 278. LITHOSPERMUM BREVIFLORUM [44]. 279. EUTOCA STRICTIFLORA [45]. 280. E. PATULIFLORA [45]. E. GLABRA (*Phacelia glabra*, Nutt.) [46].

284. CASTILLEJA INDIVISA, *Engelm.*: piloso-hispida; foliis integris lineari-lanceolatis acutis basi pleraque [47] rotundatis, floralibus apice ovato-vel obovato-dilatatis coloratis; spica demum elongata; calycis lobis late obovatis apice coloratis truncatis retusisve corolla paulo vel vix longioribus. — Valde affinis quoad flores *C. coccineæ*, et quoad folia *C. lithospermifoliæ*, ab illa imprimis foliis indivisis, ab hac statura sæpius elatiore differt, foliis acutioribus et capsulis majoribus. *Benth. in DC. Prodr. ined.* — Prairies from Houston to the Colorado: March to June. Also collected by Drummond and Berlandier.

BRAZORIA [47]. 286. B. TRUNCATA. (*Physostegia truncata*, Benth.) [48.] 287. B. SCUTELLARIOIDES [49]. 288. PHYSOSTEGIA INTERMEDIA. (*Dracocephalum intermedium*, Nutt.) [49]. 289. VERBENA BIPINNATIFIDA. (*Glandularia bipinnatifida*, Nutt.) [49]. 290. DIPTERACANTHUS (§ MEIOPHANES) MICRANTHUS [49]. 293. OXYBAPHUS PILOSA? (*Alliona ovata*, Pursh. *Calymenia pilosa*, Nutt.) [51]. 296. POLYGONUM CRISTATUM [51]. 298. ARISTOLOCHIA LONGIFLORA [51]. 311. *Potamogeton natans*, L. var. [55]. 312. SISYRINCHIUM MINUS [55].

PART II. 1850.

330. VESICARIA RECURVATA, *Engelm. ined.* [147].* 335. PARONYCHIA LINDHEIMERI, *Engelm. ined.* [152].

579. TALINUM AURANTIACUM, *n. sp.*: radice tuberosa; caule adscendente herbaceo ramoso patulo [153] folioso; foliis lanceolatis s. lineari-lanceolatis subsessilibus carnosis; floribus axillaribus singulis; pedunculis supra basin articulatis bibracteolatis, fructiferis reflexis; sepalis ovatis acuminatis tricarinatis, fructiferis subpersistentibus; petalis ovatis mucronatis; staminibus sub-25; seminibus lineis gyratis carinatis et striis tenuissimis transversis eleganter notatis. — On the Sabinas, and more abundantly, on the Liano, rare about New Braunfels, on rocky soil or almost naked rocks; in flower principally in July and August, but also at other seasons, always after heavy rains. — Root white, fleshy, tuberous, often bifurcated. Stems 8–16 inches long, ascending, much branched. Leaves 1½–2 or even 3 inches long, 2–4 lines wide. Peduncle 4–5 lines long. Sepals of the same length; petals 5 lines long and 3 wide, orange to red; filaments red; style and stigma orange. Seeds elegantly marked, black, larger than in any other North American species. — Distinct from all other species described by DeCandolle, by the single flowers.

580. TALINUM SARMENTOSUM, *n. sp.*: radice crassa; caule prostrato; ramis debilibus sarmentosis ascendentibus foliosis; foliis carnosis late ovatis cuspidatis basi attenuatis subsessilibus; cymis axillaribus bracteatis subtrifloris (rarius compositis) versus apicem laxe paniculatis; floribus longe pedicellatis; sepalis ovatis cuspidatis membranaceis deciduis; staminibus sub-15; seminibus nigris nitentibus sub lente tenuiter tuberculatis. — New Braunfels, among

* The descriptions of species quoted here by name only, are by Gray. — EDS.

shrubs on the banks of the Guadaloupe. July, September. — Stems prostrate ; branches weak, ascending, supported by the shrubs under "which the plant grows, often 6–10 feet long ;" — the specimens before me are 2–4 feet long. Lower leaves 2½–3½ inches long, 1–1¾ wide. Pedicels 6–12 and more lines long, thickened at the apex. Sepals about one line long ; flowers apparently 4–5 lines in diameter, purple. Capsule about one line long, almost [154] globose. Seeds smoother than in any other of our species.[1]

SIDA HETEROCARPA, *Engelm.* : stellato-pubescens ; caule erecto ramoso ; foliis basi subcordatis obtusis [163] crenato-dentalis, inferioribus lanceolatis, superioribus linearibus ; tuberculo sub basi petioli subspinoso ; petiolis brevibus stipulas setaceas et pedicellas solitarias s. fasciculatas superantibus ; carpellis 5 nigris divaricato-birostratis apice pubescentibus latere tenuiter rugulosis, dorso membrana tenui evanescente clausis. — Roadsides, waste places, Houston, Texas, with *S. spinosa*. Annual ? Flowers in August and September. Distinguished from *S. spinosa* by the narrower dentate-crenate (not serrate) leaves, and smaller black (not light brown) carpels, rugulose (not lacunose-reticulated) on the sides, with a prominent point on the back, broader, shorter, more divaricate not erect beaks. The seed escapes through the back, not through the regular opening at the top.

359. *Vitis candicans*, Engelm. (V. æstivalis, *Michx.*) [166]

[1] Besides these two species, we have in the flora of the United States three others very different from these, but nearly related to one another, namely, the well-known *T. teretifolium*, Pursh, *T. calycinum*, Engelm. in Wisliz. Rep., and *T. parviflorum*, Nutt. ; all three now in cultivation with me, and are well distinguished. *T. calycinum* is very ornamental ; the large flowers have sometimes six to ten petals.

PORTULACA.

Mr. Lindheimer has discovered two undescribed species in Western Texas. As these plants are so difficult to preserve and so unsightly when dried, he did not collect specimens for distribution ; but from his seeds both were raised by me last season and prove very remarkable plants, one from its near alliance with *Portulaca oleracea*, the other from its great difference from that species. I arrange the species of our flora (all of them annuals) in the following manner.

* *Spathulatæ :* glaberrimæ ; caule tereti ; foliis spathulatis obovatis ; sepalis alato-carinatis cum operculo capsulæ maturæ deciduis ; petalis flavis emarginatis s. bilobis ; capsulæ annulo circulari tumido.

1. P. OLERACEA, *L.* : foliis obovatis spathulatis apice rotundatis ; alabastro compresso ovato acuto ; sepalis carinatis ; staminibus 7–9 ; stigmatibus 5 stylum brevem superantibus ; seminibus minoribus minute sub lente verruculosis nigris. — St. Louis, very common ; flowers open in direct sunshine between 9 and 10 o'clock, A. M., August.

2. P. RETUSA, *n. sp.* : foliis cuneatis retusis, seu *emarginatis ;* alabastro compresso orbiculato obtuso ; sepalis late carinato-alatis ; staminibus sub-15 (17–19, Lindh., in plantis parvulis 7–10) ; stigmatibus 3–4 stylum æquantibus vel eo brevioribus ; seminibus majoribus sub lente echinato-tuberculatis nigricantibus. — Granite region of the Liano in Western Texas. Flowers open in direct sunshine between 8½ and 9½ A. M. (in St. Louis, in August), always before the common species. — Distinguished from the nearly allied *P. oleracea* by the broader retuse leaves, and broader calyx ; by the larger, more distinctly tuberculated, somewhat paler seeds, much larger style, and shorter and fewer stigmata. Number of stamina variable. In large specimens (bushes several feet in diameter, stems at base 6–7 lines thick, prostrate or ascending) the number counted was 15. Stigmata almost invariably 4, rarely 3.

** *Lanceolatæ :* glaberrimæ ; caule angulato ; foliis superioribus lanceolatis ; sepalis vix carinatis post anthesin deciduis ; petalis plerumque versicoloribus acutiusculis ; capsulæ ala circulari lata ex calycis basi aucta.

3. P. LANCEOLATA, *n. sp.* : *sub*-erecta ; foliis inferioribus spathulatis obtusis, superioribus lanceolatis acutis ; petalis obovatis s. oblanceolatis acutiusculis s. cuspidatis ; staminibus 7–27 ; stigmatibus 3–6 ; capsula turbinata versus apicem ala circulari lata cincta ; seminibus majoribus echinato-tuberculatis cinereis.

α. VERSICOLOR ; petalis majoribus obovatis rubris basi flavis ; staminibus 12–24 ; stigmatibus 5–6 linearibus ; capsulæ ala orbiculari plana.

β. MINOR ; petalis minoribus oblanceolatis sæpe totis flavidis rarius apice rubellis ; staminibus 7–12 ; stigmatibus 3–4 ovato-oblongis ; capsulæ ala subpentagona undulata.

Granite region of the Liano, in Western Texas. — Stems in smaller plants a few inches high, erect, with erect branches ; in larger specimens a foot or more high, as- [155] cending, very much branched. Leaves ½–1 inch long, 1–3 lines wide. Flowers 4–6 lines in diameter, very pretty in the larger forms, open from 8–9 o'clock, A. M. (St. Louis, August) ; earlier than any other species. Capsule with the wing, which is formed by the enlarged base of the deciduous calyx, 2–2½ lines in diameter. — The seeds of both forms are absolutely identical, so that the difference in the number of stamina and stigmata, and in the size and color of the flower, cannot constitute them distinct species, as Mr. Lindheimer suggests. He adds that the leaves of *α.* have an acidulous, and those of *β.* an insipid mucilaginous taste.

*** *Teretifoliæ :* ad axillæ pilosæ ; caule tereti ; foliis plus minus teretibus, basi paulo productis ; sepalis membranaceis ecarinatis cum operculo capsulæ maturæ deciduis ; petalis violaceis ; capsulæ margine circulari tumido.

4. P. PILOSA, *L.* : sepalis lineari-oblongis, petalis ovato-oblongis obtusis retusis s. emarginatis duplo brevioribus ; staminibus 15–25 stigmatibus 5–6 subæquantibus ; seminibus minutis nigris opacis minute tuberculatis. — Texas, New Mexico, Mexico, etc. — Flowers open from 9–11 or 12 o'clock in bright sunshine, 4–5 lines in diameter : stigmata glandular, hairy on the margins only, purple.

5. P. GILLIESII, *Hook.* : sepalis orbiculato-ovatis petalis orbiculato-obcordatis ter quaterve brevioribus ; staminibus numerosissimis (60) stigmatibus sub-5 exsertis longe brevioribus ; seminibus paulo majoribus tuberculatis cinereis nitentibus. — Common in cultivation, and here and there almost naturalized ; originally from Chili. Flowers 20–24 lines in diameter, open from 8 or 9 to 2 or 3 P. M. in sunshine. Stigmata glandular, hairy on the margins and upper surface, yellowish or greenish.

EYSENHARDTIA SPINOSA, *Engelm.* : fruticosa ; ramis squarrosis rachidi spicarum persistente lignosa spinosis; [174] foliis 6–8-jugis ; foliolis minutis ovatis acutis adpresse pilosis ; spicis paucifloris ; calycis obconico-campanulati dentibus triangularibus obtusis inæqualibus ; vexillo profunde bilobo ; staminibus subdiadelphis ; *ovario 4-ovulato* et stylo apice uncinato pilosis. — On Lake Eucinillas, north of Chihuahua, *Dr. Wislizenus* ; in flower, August and September. — A rough-looking, in many respects remarkable shrub, 2–3 feet high, with black bark. Leaves 4 to 6 or 7 lines long : leaflets 1–1¼ lines long. Spikes an inch long, with a stout persistent rhachis : flowers at first white, then rose-colored : uppermost (vexillary) filament shortest and almost free, adhering to the tube only at its base : style strongly hooked.

379. *Sophora sempervirens*, Engelm. mss. (S. speciosa, *Benth.*) [178]. 388. PRUNUS MINUTIFLORA, *Engelm. ined.* [185]. *Lythrum ovalifolium*, Engelm. mss. (L. alatum, *var.* ovalifolium, *Gray*) [187]. 394. ŒNOTHERA SERRULATA, *c.* PINIFOLIA, *Engelm.* [189]. (611.) GAURA SUFFULTA, *Engelm. mss.* [190].

PASSIFLORA TENUILOBA, *Engelm.* : petiolis brevibus eglandulosis ; foliis supra pilis brevibus subscabris [192] subtus glabriusculis trinerviis reticulatis basi biglandulosis subcordatis trilobis, lobis lateralibus lanceolato-linearibus elongatis cuspidatis horizontaliter divergentibus vel recurvatis, medio brevissimo in fol. inferioribus integro in superioribus breviter trilobo; stipulis setaceis; pedunculis binis petiolum bis superantibus; cirrho elongato simplici; floribus exinvolucratis apetalis ; calyce 5-lobo virescente. — On the Liano ; coll. in October. — Apparently near *P. normalis*, L., of Jamaica, which is unknown to me. Herbaceous, sub-erect, slender. Petioles 2, the peduncles 3–3½ lines long. Leaves rather rigid, with revolute margins, 5 or 6 lines long, but from 3 to 5 inches in transverse diameter ; the lobes about 3 lines wide, the lateral ones sometimes bearing a posterior tooth or lobule. Flowers 8 or 9 lines in diameter. Only a single specimen was gathered by Lindheimer.

DAUCOSMA, *Engelm. & Gray.* [210]. 404. D. LACINIATUM, *Engelm. & Gray.* [211].

SYMPHORICARPUS SPICATUS, *Engelm.*: foliis obovatis obtusis brevissime petiolatis supra demum glabratis [215] subtus pubescentibus pallidis ; floribus (15–30) in spicas axillares arcte glomeratas congestis ; corollis intus barbatis ; baccis rubris. — Shady bottom woods, New Braunfels. A small shrub, 2 or 3 feet high, with numerous slender branches. Leaves about three-fourths of an inch long, half an inch wide ; the lower leaves wider, almost orbicular. Spikes from 4 to 6, or in fruit 8 or 10, lines long. Flowers a little smaller than in *S. glomeratus*, to which our species bears a strong affinity. It is, however, distinguished by its smaller, obtuse leaves, the spiked flowers, the larger and apparently more juicy fruit, and the broader, more compressed seeds. Of the numerous flowers in each spike only a few mature fruit.

407. FEDIA (VALERIANELLA) STENOCARPA, *Engelm. mss.* The fruit is not only much smaller and [217] more slender than that of *F. radiata*, but the proportion of the empty cells is different ; these being much smaller than the seed ; while in the former they are about equal, and in *F. carinata* (which has a different habit,) larger. Cauline leaves often deeply dentate at the base, or almost pinnatifid, but sometimes entire.

FEDIA AMARELLA, *Lindh. mss.* : glaberrima, erecta, versus apicem dichotomo-cymosa ; foliis inferioribus spathulatis basi longe attenuatis, superioribus oblongo-linearibus sessilibus vel basi subcordatis, omnibus integris obtusis ; fructibus minimus subgloboso-ovatis obtuse auriculatis hispidis, loculis sterilibus fertili subgloboso multo angustioribus brevioribusque pene obliteratis. — Comanche Spring ; flowering in May. — Plant 8 to 12 inches high, in habit similar to *F. radiata* and *F. stenocarpa;* but the leaves are entire in all the specimens ; and the fresh herb has a bitter taste, which the other species have not. The fruit is much smaller than in any other species known to me ; the sterile cells many times smaller than the seed, their cavity almost obliterated.

337. LINUM RUPESTRE, *Engelm. ined.* [232]

PASSIFLORA AFFINIS, *Engelm.* : herbacea, scandens, elata, glabra ; foliis trilobis subtus glaucis petiolisque [233] eglandulosis, inferioribus subcordatis, superioribus basi subacutis, lobis subæqualibus obovatis obtusis setaceo-mucronatis integris ; stipulis setaceis ; pedunculis binis petiolum æquantibus vel superantibus 3-bracteatis, cirrho intermedio elongato simplici ; petalis calycis lobis obtusis brevioribus et angustioribus (flavescentibus) ; baccis (cæruleo-atris) stipitem æquantibus. — Comanche Spring, climbing high over trees, in shady places. August-September. — Near *P. lutea* in aspect ; from which it is distinguished by the bracteate peduncles, the deeply lobed leaves, the larger flowers, smaller seeds, &c. Lower leaves 3 inches long, and 4 wide, less deeply lobed than the upper, which are deeply divided. Petioles 4–12 lines long. Peduncles 12–15 lines long. Bracts 3, rarely 2, subulate, oblanceolate, or obovate, mucronate, often distant. Flowers 16 lines in diameter ; the fimbrillæ as long as sepals. Stipe half an inch in length, longer in proportion than in any other of our species. Berry of the same diameter. Seeds ovate, mucronate, transversely rugose, smaller and more turgid than in *P. lutea*. — DeCandolle's division of the genus, which would separate this species from *P. lutea* on account of the bract, must be erroneous ; moreover, *P. lutea* has not "perigonium s. calycem 5-lobum," but 10-lobum, as well as our species.*

* The following genera and species jointly named by Gray and Engelmann, and enumerated in Plantæ Lindheimerianæ, part 2, were first published in a paper, by Asa Gray, on new genera and species of *Compositæ* from Texas (Proc.

III. DESCRIPTIONS IN GRAY'S PLANTÆ FENDLERIANÆ.*

From the Memoirs of the American Academy, n. s., Vol. IV. 1849.

13. Thalictrum Fendleri, *Engelm.* : dioicum : foliis petiolatis; petiolulis primariis brachiatis vel refractis [5] stipellatis ; foliolis cordato-rotundatis trilobis; filamentis apice vix incrassatis ; antheris setigero-mucronatis ; carpellis sessilibus oblique ovatis complanatis costatis carinato-alatis stylo recurvo triplo longioribus ; cæt. fere *T. Cornuti.* — About Santa Fé. (*T. Cornuti*, of which a few specimens gathered on the Mora River were distributed with this species, has the fruit terete, with the prominent ribs all equal.)

17. *Corydalis montana*, Engelm. mss. (C. aurea, *Willd.* var). [6]

29–31. Sisymbrium incisum, *Engelm.* : annuum vel bienne; caule glabriusculo seu puberulo seu glandu- [8] loso-piloso ; foliis pinnatisectis, segmentis lanceolatis vel lineari-lanceolatis inciso-serratis ; petalis flavis lanceolato-spathulatis calycem superantibus ; pedicellis calyce ter-quaterve longioribus, fructiferis (racemo fructifero elongato) patentibus capillaribus siliquas lineari-filiformes erecto-patentes subæquantibus ; valvis indistincte uninerviis. — Banks of streams in New Mexico ; Santa Fé Creek and Mora River ; June to August.

Drymaria nodosa, *n. sp.* : annua, diffusa, trichotomo ramosissima; ramis basis nodosis tumidis brachiatis ; [12] internodis superne glanduloso-puberulis ; stipulis filiformibus ; foliis linearibus canaliculatis glabris ; floribus in dichotomia ramulorum pedunculatis ; sepalis lanceolatis acuminatis trinerviis; petalis ad unguem bipartitis, lobis oblongo linearibus retusis s. emarginatis calycem superantibus ; staminibus 5 disco carnoso quinquelobo-insi-dentibus ; ovario breviter stipitato subgloboso pluriovulato ; calyce persistente clauso capsulam duplo breviorem [13] includente ; seminibus circa 3 asperis. — Cosiquiriachi, in the State of Chihuahua ; flowers in June and July. — About 6 inches high, much branched and diffuse; branches at right angles with the stem. Styles of two shapes, short with minute stigmata, and longer than the ovary with 3 distinct recurved stigmata ; both forms on the same plant, and both flowers apparently equally fertile.

72. Talinum calycinum, *Engelm.*, *Wislizen. Report*, 1848, *p.* 88 [redescribed]. [14]

DISPOSITION OF PERENNIAL GERANIA. [26]

Perennes ; pedunculi biflori ; valvulæ capsulæ læves, plus minus pilosæ ; semina reticulata seu rugosa.

* Pedicelli deflorati erecti seu suberecti.

1. G. Richardsonii, *Fisch. & Mey. G. albiflorum*, Hook.; Torr. & Gray ; non Ledeb.: caule erecto cum petiolis glabriusculo ; pedicellis tenuiter glanduloso-pubescentibus ; filamentis basi pilosis calycem et stylos pilosis tertia parte connatos æquantibus ; valvis capsulæ parce pilosiusculis ; rostro glanduloso-pubescente ; petalis albis. — [27] Distinct from the next by the greater smoothness, the hairy and much less connate styles, the pilose (not short-ciliate) filaments, and the more delicately reticulated seeds.

2. G. maculatum, *Linn.*: caule erecto cum petiolis retrorso-piloso ; pedicellis glanduloso-pubescentibus ; filamentis basi breviter ciliatis calyce stylisque nudis ultra medium connatis subbrevioribus ; valvis capsulæ longe pilosis ; rostro glanduloso-pubescente.

3. G. pentagynum, *Engelm. in Wisl. Rep.* : caule erecto cum petiolis retrorso-pubescente ; pedicellis glanduloso-pubescentibus ; filamentis basi pilosis calycem et stylos nudos ima parte solum connatos æquantibus ; valvis capsulæ pilosiusculis ; rostro glanduloso-pubescente. — Eastern Mountains of New Mexico, on Wolf Creek. — Nearer *G. maculatum* than any of the others : distinguished by the characters above enumerated ; also by the finer, more closely adpressed pubescence, the smaller leaves with narrower segments and much more prominent veins ; inner sepals with colored margins, emarginate or somewhat bilobed : seed not seen.

4. G. Fremontii, *Torr.*

5. G. Mexicanum, *Kunth.*

* * Pedicelli deflorati declinati seu refracti.

+ Flores violacei.

6. G. cæspitosum, *James.*

Amer. Acad. Arts and Sci. vol. i. 1846, pp. 46–49). The numbers prefixed and the first pagination are those of Plantæ Lindheimerianæ ; the second pagination is that of first publication. — Eds.

408. Vernonia Lindheimeri [217. 46]. 412. Brickellia cylindracea [218–219. 46–47]. 415. Keerlia bellidifolia [220. 47]. LINDHEIMERA. 424, 638. L. Texana [225–226. 47]. 431. *Tetragonotheca Texana* (Halea Texana, *Gray*), [227. 48]. BARRATTIA. 433. B. calva (Simsia calva, *Gray*) [228. 48]. AGASSIZIA. 437. 646. A. suavis [229–230. 49].

* An account of the route traversed by Fendler, contributed to this paper by Dr. Engelmann (pp. 2–3), is omitted. — Eds.

7. G. GRACILE, *n. sp.*: caule erecto divaricato-ramoso cum petiolis et pedicellis retrorso-piloso; filamentis basi piloso-ciliatis calyce et stylis pilosis ima parte solum connatis brevioribus; valvis capsulæ pilosiusculis; rostro pubescente. — Pine woods, on the mountains of Cosiquiriachi, State of Chihuahua; collected in October, by Dr. Wislizenus. — Resembling the last; but erect, more hirsute pubescent; the flowers, fruit, and seed smaller; stamens shorter; styles hairy, more deeply divided; and the peduncles much shorter, mostly of the length of the pedicels. — Near *G. Mexicanum*, Kunth?

+ + Flores albidi.

8. G. HERNANDEZII, *DC.*: caule divaricato-ramoso cum petiolis patentim piloso; pedicellis glanduloso-pilosis; filamentis basi breviter ciliatis calycem et stylos pilosos ad medium connatos æquantibus; valvis capsulæ parce pilosiusculis; rostro glanduloso-piloso. — Pine woods, on the mountains of Llanos, State of Chihuahua; collected in October, by Dr. Wislizenus. Leaves $1\frac{1}{4}$ to 2 inches in diameter, the upper truncate at the base; peduncles as long as, or shorter than, the pedicels; flowers white, about 8 lines in diameter.

180. CALLIANDRA? HERBACEA, *Engelm.*: caule humili erecto flexuoso adpresse piloso; stipulis lanceolatis [39] nervosis; foliis longe petiolatis; pinnis 3–4-jugis; foliolis 20–30 obliquis oblongis obtusiusculis ciliatis supra glabris subtus laxe reticulatis adpresse pilosis; capitulis florum binis folio brevioribus, pauci-(8–10-)floris; calycibus tubulosis 4–5-dentatis, dentibus tubo subbrevioribus ciliatis; tubo corollæ calyce triplo longiore dentibus obtusiusculis apice parce pilosis; staminibus 25–30 corollam longe superantibus. — Between San Miguel and Las Vegas; flowering in August. — Plant apparently perennial, 6 inches high: leaves with petioles 3 inches long: leaflets 3 lines long: heads about 1 inch in diameter, on peduncles of 1 inch in length. Flowers polygamous: a fertile flower which I examined had 4 calyx and 4 corolla teeth; a sterile one, 5 teeth: stamens united at the base, more so in the fertile flower. Ovary elongated, with many ovula and the tumid sutures glabrous.

C. CHAMÆDRYS, *Engelm.*: fruticosa, humilis; ramulis petiolisque brevibus eglandulosis pubescentibus; foliis 2–3-jugis rarius 1-jugis; foliolis 6–12-jugis minutis ovatis obtusis seu acutiusculis supra glabris subtus pilosis; stipulis subulatis rigidis erectis subpersistentibus; capitulis breviter pedunculatis singulis binisve pauci-(4–8-)floris; floribus hermaphroditis; calyce campanulato subinæqualiter 5-dentato, dentibus obtusis pilosis; corolla tubuloso-campanulata calycem ter quaterve superante ad medium 5-fida extus parve pilosa (purpurea). lobis lanceolatis acutis subæqualibus; staminibus polyadelphis basi in tubum connatis elongatis tenuissimis circiter 35; ovario lineari-lanceolato suturis incrassato glaberrimo; stylo tenuissimo capillaceo stamina superante; stigmate capitato; legumine lineari-lanceolato stipitato acuminato (immaturo) albo-sericeo marginibus valde incrassatis subnudo. — Chihuahua, *Dr. Wislizenus, Dr. Gregg;* flowering in April. — Stems squarrose, much branched, 3 to 12 inches high, stout. Leaves 4 to 8 lines long: leaflets $\frac{3}{4}$ to 1 line long. Peduncles 3 to 4 or 5 lines long. Stamens an inch long. Legume $1\frac{1}{2}$ to 2 inches long, $\frac{1}{4}$ inch wide, white silky, while the ovary is perfectly glabrous! — The specimens of Dr. Wislizenus, from Bachimba, are smaller, more branched; the leaflets smaller, obtuse, more hairy, and not more than bijugate, the lobes of the corolla recurved. Dr. Gregg collected in the Cañon of Ojito larger specimens, with often acutish leaflets, and larger flowers, with the lobes of the corolla erect. — Apparently near *C. Californica* and *C. Xalapensis*, Benth., but well distinguished by the very small leaflets, &c.

IV. DESCRIPTIONS IN GRAY'S PLANTÆ WRIGHTIANÆ.

FROM THE SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE, VOL. III. ARTICLE 5, 1852, AND VOL. V. 1853.

PART I. 1852.

30. PORTULACA RETUSA, *Engelm. Pl. Lindh.* 2, *p.* 154. Valley of the Rio Grande below El Paso, in [13] sandy soil. The long style and the broadly winged sepals are decisive as to the identity of this species. The seeds are of the same size and roughness as those of Lindheimer's specimens, but opaque and black, not grayish. The only specimen before me is a small erect plant, without any flowers. [In Mr. Wright's notes the flowers are said to be "yellow and minute."] — To the character of the *Spathulatæ* in Pl. Lindh. l. c. add: *Operculo capsulæ acuto sub apice constricto semina unum plurave includente.* I had overlooked this remarkable fact; but it constantly occurs in all the species of this section, both European and American.

31, 32. P. PILOSA, *Linn.* W. Texas to New Mexico. I have before me specimens from six different localities, from the Brazos westward, collected by Lindheimer and Wright, differing from one another in the size and appearance of the seeds and in the shape of the capsule; but these differences vary so much that even varieties can hardly be characterized. In some the capsule is small with a long stipe, the operculum conic, the seeds very minute, and more or less shining with metallic lustre. In others the capsule is more than twice as large, the operculum semiglobose, the stipe very short, and the much larger seeds black and opaque.

TALINUM AURANTIACUM, *Engelm. Pl. Lindh. l. c.* Common throughout Southwestern Texas. Also found [14] by Dr. Wislizenus in the Jornada del Muerto.

33. T. AURANTIACUM, β. ANGUSTISSIMUM : foliis anguste linearibus ; pedunculis ad basin vel vix supra basin articulatis ; sepalis magis membranaceis quam petala brevioribus ; stylo stamina æquante ovario vix longiore. — Bottoms of Live Oak Creek, and on the San Felipe; July.

34. T. SARMENTOSUM, *Engelm. Pl. Lindh. l. c.* On the Liana ; June. Root thick, tuberous. To characters add: *Bracteolis subulatis.*

35. T. SPATHULATUM, *n. sp.* : caule erecto gracili folioso ; foliis carnosis oblanceolato-spathulatis breviter cuspidatis in petiolum sensim attenuatis ; cymulis axillaribus bracteatis laxe trifloris versus caulis apicem in paniculam dispositis ; bracteis ovatis cuspidatis minutis deciduis ; floribus longe pedicellatis [corolla ex. cl. Wright flava] ; seminibus nigris nitentibus tuberculatis. — Mountains of New Mexico east of the Rio Grande ; August. Well distinguished from the nearly related *T. sarmentosum* by the narrower, spatulate leaves (2–3 inches long, and half an inch or more wide), by the short ovate bracts, the larger capsule, and the very much larger seeds, which are much more distinctly tuberculate.

NOTES ON LINUM.

LINUM, *L.* (Dehiscence of the capsule only, or at least most readily, through the false dissepiments!) [25]

Sect. ADENOLINUM.

1. LINUM PERENNE, *Linn.* Collected for the first time in Mexico by Dr. Gregg, in dry valleys near Saltillo, Sept. 1848. Secondary dissepiments incomplete, with capillary fibres on their margins, much as in *L. Boottii.*

Sect. LINOPSIS.

§ 1. Capsules 5-valved ; the secondary dissepiments more or less membranaceous, but entire ; styles united to above the middle, mostly to near the apex.

2. L. MULTICAULE, *Hook.* — *L. hudsonioides,* Planch., is a mere variety. Styles mostly united almost to the tips. Capsule obtuse, as long as or a little shorter than the calyx ; the secondary dissepiments entirely membranaceous, falling away to let the seed escape. Texas, from the coast (Houston and Victoria) to the West (N. Braunfels, Pierdenales, etc.). — Sepals persistent, even after the fall of the capsule, while in all other species they fall off when the fruit ripens.

3. L. ARISTATUM, *Engelm. in Pl. Wisl. p.* 101. Leaves sometimes with stipular glands. False dissepiments for the greater part membranaceous, with a narrow falciform cartilagineous part exteriorly and inferiorly. — Between El Paso and Chihuahua. Wright's No. 72 is a smaller form of this species ; the sepals rather less aristate ; the flowers and capsules a little smaller, and with a large and perpendicular ligneous root.

4. L. RIGIDUM, *Pursh.* Glaucous ; stem simple below ; leaves, at least the upper ones, glandular-serrate, without stipular glands ; pedicels thickened at the end, forming a cup-shaped exterior caliculus ; styles almost entirely united ; filaments subulate from a triangular base ; capsule not seen. (My specimens were collected by Geyer, on the Upper Missouri.)

Var. PUBERULUM. Glaucous ; stems very much branched from the base, puberulent, or rarely glabrate ; leaves erect, linear, 1-nerved, mucronate, a pair of stipular glands at their base ; pedicels equalling or exceeding the calyx ; sepals glandulose-ciliate, the exterior 3-nerved ; filaments with an ovate-triangular base, toothless ; styles united to the summit ; capsule rather shorter than the sepals, ovate, acutish, 5-valved, the secondary dissepiments almost entirely membranaceous. — Santa Fé, to the Cimarron River, *Fendler,* No. 85. Prof. Gray in Pl. Fendl. considered it a variety of *L. Berlandieri,* and in Pl. Lindh. p. 157, as belonging to *L. rigidum.* From the former it is distinguished by the glaucous appearance, the linear leaves, and especially the small capsule with the almost entirely membranaceous secondary dissepiments. From the latter, the absence of the caliculate cup below the calyx, the smaller flowers, and the entire leaves appear to separate it. [Dr. Engelmann inclined to consider this a distinct species; but the capsules of true *L. rigidum,* in the Hookerian herbarium, show precisely the same structure, and others rightly named "*L. rigidum*" by Planchon have manifest stipular glands, although he has not noticed them; so that it would be wrong, I think, to separate the present plant specifically. It is evident that the stipular glands do not furnish reliable specific distinctions. — A. G.]

5. L. BERLANDIERI, *Hook.* Green ; leaves lanceolate or lanceolate-linear; stipular glands often present, but not always ; filaments lanceolate-subulate at the base ; capsules globose-ovate, subacute, 5-valved, the secondary dissepiments partly (the upper and inner half) membranaceous. — From Galveston to the Brazos, N. Braunfels, [26] and the Pierdenales, *Lindheimer,* &c. On the San Pedro River, *Wright.* — The latter approaches a slightly glaucous form, with narrower and more rigid leaves, which occurs on the Cimarron (*Wislizenus, Fendler,* mixed with

No. 85), often only two or three inches high, but much branched, with manifest stipular glands; the capsule ovate and acute. It appears very near to *L.* [*rigidum* var.] *puberulum;* but the structure of the false dissepiments is decisive.

§ 2. Capsules 10-valved.

* Styles united at the base or below the middle.

6. L. BOOTTII, *Planchon.* Annual; styles in northern (St. Louis) specimens united at or below the lower third only, in Texan specimens (β. *Planchon*) almost to the middle; capsules globose, acute, 10-valved; the secondary dissepiments incomplete, with numerous hair-like fibres on the margin. — No. 86, Pl. Fendl. belongs here, and not to *L. rigidum.* This is the only one of our species with a 10-valved capsule, where the styles are somewhat united.

* * Styles free to the base.

† Secondary dissepiments incomplete.

7. L. RUPESTRE, *Engelm. in Pl. Lindh.* 2, *p.* 232. Capsule globose-ovate, acute or cuspidate, like that of the foregoing species, but smaller; secondary dissepiments exactly the same; distinguished principally by the perennial ligneous root, the subulate leaves, the smaller flowers and fruit, and the entirely free styles. — Found by Lindheimer about New Braunfels and Comanche Spring; by Wright (No. 71) on Turkey Creek. Dr. Gregg collected it near Saltillo in June, and a variety, which may be named β. *cymulosum*, on the battle-field of Buena Vista in May; this latter may be distinguished by the small and crowded cymes at the end of the branches.

8. L. GREGGII, *n. sp.*: viride, glabrum, caulibus pluribus e rhizomate ligneo adscendentibus a basi fruticulosa ramosis angulatis; foliis alternis inferioribus oblanceolatis superioribus lanceolatis patulis; glandulis stipularibus geminis rarius inconspicuis; cymis virgatis dissitifloris contractis; pedicellis calyce sæpius longioribus; sepalis lanceolatis acutis trinerviis margine glandulosis; filamentis basi brevi dilatatis 2-denticulatis; stylis liberis; stigmatibus cohærentibus; capsula depresso-globosa cuspidata calycem subæquante 10-valvi, dissepimentis secundariis incompletis. — Near Saltillo, Sept. 1st, 1848, *Dr. Gregg*, No. 387. — Stems about 10 inches high. Leaves similar to those of *L. Virginianum*, the capsule and seeds of the same size. Distinguished from *L. rupestre* by the broader leaves, much smaller flowers and fruit, the singular united stigmata, which I have found in all the flowers (and many of them) examined by me, and the hairless false dissepiments. Apparently near *L. Mexicanum*, but that species has opposite leaves, &c.

† † Secondary dissepiments complete and similar to the primary ones: capsule splitting into 10 closed cocci.

9. LINUM VIRGINIANUM, *Linn.* Biennial (or perennial?) with a fibrous root (all the others have a tapering simple root).

Var. β. OPPOSITIFOLIUM: caule erecto; foliis plurimis oppositis obovatis seu oblongis obtusis; panicula patula; sepalis integerrimis late ovatis acutis; petalis flavis. — Little Rock, Arkansas, in springy morasses with Sphagnum. Flowers smaller than in the usual form.

Var. γ. ANGUSTIFOLIUM: caule stricto; foliis erectis; panicula contracta sparsiflora; sepalis lanceolatis capsulam superantibus, interioribus glandulosis; petalis sulphureis. — Western Arkansas, on sandy hills in open woods. Flowers and fruit larger than in the common form.

81. *Zanthoxylum digynum*, Engelm. in litt. (Z. Carolinianum, *Lam.*) [31].

84. RHUS MICROPHYLLA, *Engelm. in litt.*: fruticosa; ramulis verrucosis; foliis impari-pinnatis 3–4-jugis, rha- [31]
chidi alata; foliolis sessilibus parvis ovalibus obtusis v. mucronatis basi acutis integerrimis seu levissime crenulatis pilosulis; floribus dioicis amentaceis præcocibus basi tribracteolatis; petalis ciliatis; drupa globosa subcompressa glandulari-pilosa, putamine lævi. — Margins of thickets, on the top of hills, in the large prairie between New Braunfels and San Antonio, 15 miles from the former place, 1850; also gathered, without developed flowers, in 1846. It blossoms in March, and shows ripe fruit in May. A large shrub: stems one or two inches in diameter, branching above, with numerous small branchlets. Leaflets 3 or 4 lines long. Disk 5-lobed, the lobes emarginate. A true *Lobadium* with pinnated leaves.

Vitis candicans, Engelm. ined. (V. coriacea, *Shuttleworth*) [32]. HIRÆA SERICEA, *Engelm. ined.* [37]. ASTRAGALUS LINDHEIMERI, *Engelm. ined.* [52]. DESMODIUM WISLIZENI, *Engelm. ined.* [53].

FENDLERA, *Engelm. & Gray* [77]. SANVITALIA ANGUSTIFOLIA, *Engelm. in coll. Gregg* [112]. POROPHYLLUM AMPLEXICAULE, *Engelm. ined.* [120].

PART II. 1853.

Clematis coccinea, Engelm. mss. (C. Viorna, var. coccinea) [7]. *Corydalis curvisiliqua*, Engelm. (C. aurea, *Willd.* var.) [10].

V. DESCRIPTIONS IN ENGELMANN'S BOTANY OF THE UPPER MISSOURI.

From Hayden's Report on Geology and Natural History, in the Transactions of the American Philosophical Society, n. s., Vol. XII. 1861, pp. 182–209.*

Nasturtium calycinum,† *Engelm., n. sp.*: annuum erectum seu diffusum, hirsutulum; foliis cau- [184, 730]
linis anguste oblongis sinuatis seu subpinnatifidis basi auriculata arcte sessilibus vel semi amplexicaulibus;
racemosis confertifloris demum elongatis; pedicellis flore flavido et silicula ovoidea acuta parva hispidula cum stylo gracili vix longioribus; calyce persistente. In aspect as well as in the style (fully a line long on a silicle 1½ line in length), this species resembles some *Vescicariæ*, but the numerous seeds are those of a *Nasturtium*. The stem is about a foot high, often much branched and diffuse. The ovate-lanceolate acutish sepals commonly persist until the valves of the pod have fallen. The pubescence of the pod consists of very short and pointed thick-based simple hairs (A. Gray). Sandy bottoms of the Yellowstone River; Fort Sarpy to Fort Union.

Machæranthera viscosa (*Dieteria viscosa*, Nutt.). [195]

Lithospermum breviflorum, var. punctulosum, *Engelm.*: hispidum, caulibus e radice perpendiculari [203]
pluribus, erectis foliis linearibus; floribus pseudo-axillaribus minutis; nucibus minoribus undique exsculpto punctulosis. Sandy bottoms about Fort Union at the mouth of the Yellowstone River. The flowers are absolutely identical with those of the last [*L. breviflorum*], otherwise the much greater roughness and the curiously punctate nuts would seem to indicate specific difference.

VI. FROM GRAY'S MANUAL OF THE BOTANY OF THE NORTHERN UNITED STATES.

The following species are named by Engelmann, who contributed notes on *Cuscuta, Euphorbia, Alisma, Sagittaria,* and *Echinodorus,* to the second edition; also on *Vitis, Callitriche, Pinus, Juncus, Naias, Lemna, Wolffia, Sparganium,* and *Isoëtes,* to the fifth edition. — Eds.

Second Edition, 1856.

Cirsium filipendulum, Engelm. (C. Virginianum, *Michx.*, var. filipendulum) [233]. Sparganium eurycarpum, *Engelm.* n. sp. [430]. *Cyperus tenuior*, Engelm. (C. Engelmanni, *Steud.*) [492]. Eriophorum gracile, *Koch*, var. paucinervium, *Engelm.* [502].

Fifth Edition, 1868.

Corydalis aurea, *Willd.*, var. micrantha, *Engelm.*; var. occidentalis, Engelm. (*C. montana*, Engelm.) C. curvisiliqua, *Engelm.* C. crystallina, *Engelm.* [62]. Aster anomalus, *Engelm.* [235]. Callitriche Austini, *Engelm.* [428]. Quercus rubra, *L.*, var. runcinata, *Engelm.* [454].

VII. NOTE ON POLYGONUM TENUE.

From the Proceedings of the Academy of Natural Sciences of Philadelphia.

Polygonum tenue, *Michx.* *a.* commune: majus; nucibus majoribus (sesquilineam longis). *β.* microsper- [75]
mum: minus, gracilius; nucibus vix lineam longis. *γ.* latifolium: humile; foliis oblongis; spicis coarctatis; bracteis superioribus (aristo destitutis) muticis. Meisner, in the Prodromus, is wrong in saying that the nuts are sub-opaque or rough on the edge; they are perfectly smooth and shining, with concave sides and an acumination. — [Mar. 1863, as a note to a paper by Asa Gray on plants collected in the Rocky Mountains by Hall & Harbour.]

* It has been thought best not to print the entire list, which is a reprint, with some additions, of the list of plants identified by Engelmann, and published in the Report of the Secretary of War for 1858, vol. ii. pp. 728–744, and Preliminary Report of Explorations in Nebraska and Dakota in the years 1855–1857, by Lieut. G. K. Warren. Washington, 1859, pp. 152–173. — Eds.

† First published in Preliminary Report of Explorations in Nebraska and Dakota, 1855–1857; Lieut. G. K. Warren, T. E. Catalogue of Plants. — Eds.

VIII. BOTANY OF SIMPSON'S EXPEDITION.

From Report of Explorations across the Great Basin of Utah in 1859, in Charge of Capt. J. H. Simpson. Washington, 1876.

Cercocarpus ledifolius, *Nuttall in Torrey & Gray's Fl. N. Am.* 1, *p.* 427 ; *and in his continuation of* [435] *Michaux's Sylva*, 2, *p.* 28, *t.* 51 ; *Hooker, l. c. pl. t.* 324. — Mountain-Mahogany of the inhabitants of Utah.

This small evergreen tree is so well described by Nuttall in both works mentioned that not much remains to be added. His figure, however, is not a very faithful representation. He says that it grows much like a peach tree, at most 15 feet high, and that the trunk is sometimes as much as a foot in diameter. On the expedition it was found to grow rarely as a tree, but usually branching from the base, or several stems from one root; its height was from 8–15 feet, and the stems seen had the thickness of 3–6, or, at most, 10 inches. The bark is light gray, tough, smoothish, with superficial longitudinal wrinkles and short transverse scars. The wood is hard, heavy, very close-grained, light reddish-brown, with white sap; medullary rays very numerous, but extremely fine, scarcely visible with the naked eye; the wood is similar to cherry-wood, but harder and heavier. A specimen before me has a diameter of 16 lines, 14 lines of which are wood, showing 24 annual rings, so that each ring has a thickness of not much more than ½ line. The shoots, or longer branches, have a white, smooth bark, with joints or internodes of about 1 inch in length. The leaves, however, are usually crowded at the end of lateral branchlets, a few lines to 1 or 1½ inches in length [436] closely covered with circular scars. Leaves very thick and leathery, persistent, lanceolate, acute at both ends, entire and revolute at the margin, with a thick midrib, prominent on the lower surface, 9–14 lines long, 2½–3½ lines wide, on a petiole 1½–2 lines long, to the lower part of which adhere lanceolate, brown, scarious stipules. When young, the branchlets as well as the leaves are covered all over with short, curly hair; when older, the leaves become glabrous and glossy on the upper surface, the lower remaining hairy and assuming a rusty color. The sessile flowers are produced in June from the axils of the uppermost leaves of the preceding year's growth, either single or 2 or 3 together; short scarious bracts envelop the base of the cylindrical, woolly, calyx-tube, which is 3 lines long; its 5-lobed, white limb, 3–4 lines in diameter, is very woolly externally, and less so internally, and bears about 20 or 25 naked, slender filaments, with reniform anthers ½ line in diameter. Immediately after flowering, the silky-feathery style becomes elongated, and carries up with it the detached limb of the calyx; at maturity, the style becomes a twisted, feathery tail of about 2 inches in length; the inconspicuous, linear, hairy fruit itself is about 4 lines long, and remains hid in the persistent calyx-tube; at its top and base I observe a beard of very curious, stiff white bristles, less than a line in length, thicker in the middle, and tapering toward both extremities. The fruit seems to be somewhat persistent, as I find it in specimens collected in spring before the flowering-season. About the time of flowering, the young leaves begin to develop at the end of the branchlets, leaving the flowers between them and the leaves of the year before. I generally find four or five leaves of the same year's growth at the end of each branchlet; they probably fall off when about 15 or 18 months old. This fine tree, discovered by Nuttall on Bear River, north of the Salt Lake, and near "Thornberg's Ravine" in the Rocky Mountains, was found by the expedition on the Lookout Mountains and other mountain-chains of the basin.*

. . . . . .

The name of "Wild Sage," now so familiar to every traveller in our western mountain-deserts, was first [444] used by Lewis and Clarke, in the narrative of their adventurous expedition, to designate several species of *Artemisia* or *Wormwood*, distantly resembling the true garden sage, *Salvia officinalis*, by their gray foliage and aromatic odor. It seems that now this name has, by common use, been restricted to the larger shrubby species, which give a peculiar character to the arid plateaus of Western North America, and which are of the highest importance to the traveller as "furnishing the sole article of fuel or shelter which they meet in wandering over these woodless deserts," as already Nuttall informs us in his genera of North American Plants, 2, p. 142. He states that the "Wild Sage" is his *Artemisia Columbiensis*, which name was by him improperly substituted for the prior name of *A. cana*, described by Pursh from the original specimens of Lewis and Clarke. Torrey and Gray, in their Flora of N. America, 2, p. 418, doubt whether this really is the "Wild Sage" of those travellers, and come to the conclusion that that name was indiscriminately applied to several shrubby species ; they further state that the plant given by Governor Lewis to Pursh as "the Sage" is the herbaceous *A. Ludoviciana* found on the homeward voyage on the Missouri River.

I have now the means, through information obtained from Mr. H. Engelmann and from Dr. F. V. Hayden, to throw a little more light on this question, which is not without importance for botanical geography. The two species here in question are: —

Artemisia cana, *Pursh, Fl. Am. Sept.* 2, *p.* 521 ; *Torrey & Gray, Fl. N. Am.* 2, *p.* 418. — Shrubby, with woody stem 2–4 inches in diameter, 2–4 feet (on the Yellowstone, *Dr. Hayden*) or 2–6 feet high (on the Laramie

* The account of *Cactaceæ*, which came here, is reproduced above (pp. 229–233). — Eds.

Plains, *H. Engelmann*). Stem covered with a light-gray bark, which is separated into many layers of loose shreds connected by smaller transverse fibres, and is readily torn off. Wood light, porous, pale-colored, with very many darker brown medullary rays, easily separating along the division of the annual rings. These rings, or layers, are from ½–1 line in thickness, as stems of 1½–2 inches diameter show about a dozen rings, and are consequently as many years old. The stems are rarely cylindrical, but mostly compressed, knotty, and variously twisted, and often stunted ; they are sometimes divided from the base, but oftener bear short and thick branches higher up. The annual branchlets are crowded along the older branches, 8–12 inches long, densely coated with a soft, white pubescence, and crowded with silvery-gray leaves, and bear toward their upper part and on the numerous short and erect lateral branchlets a profusion of small flower-heads, forming a spiked or contracted panicle, interspersed with short leaves. The leaves are flat, linear-lanceolate, entire or (the lower ones) rarely lobed, 1–2 or 2½ lines wide and 1½–2 inches long, the upper ones becoming smaller. The flower-heads are mostly sessile, or nearly so, hemispherical, about 2 lines long and wide; outer scales of involucrum shorter, foliaceous, and canescent (sometimes the lowest ones larger than the flowers, and pointed) ; inner scales nearly as long as flowers, brownish, scarious, obtuse, cottony-fimbriate on the margins. The flowers are all perfect, usually 5, in some specimens as many as 8 in number, 1½ lines long ; ovary glandular, and, when bruised, with the odor of wormwood.

This is the "Wild Sage" of the Upper Missouri (above the mouth of the Yellowstone) and the Yellow- [445]
stone River, and of the Laramie Plains, but it does not seem to occur west of the Rocky Mountains, as Torrey and Gray (*l. c.*) already state, and Nuttall (*l. c.*) must have confounded it with other species, when he contends that it is "still more abundant on the barren plains of the Columbia River," and that it grows 6 to 8 or 12 feet high.

ARTEMISIA TRIDENTATA, *Nuttall in Trans. Amer. Phil. Soc.* (*n. ser.*) 7, *p.* 398 ; *Torrey & Gray, Fl.* 2, *p.* 418. — Trunk, bark, and wood very similar to that of the last species, but trunk often larger, and usually even more twisted and knotty, with very numerous short and stunted branches, which are repeatedly divided into a great many smaller branchlets ; ultimate annual branchlets fascicled, erect, only 3–6 inches long, canescent or silvery, very leafy at base, rather naked upward, bearing strict, rather compact, paniculate spikes, composed of sessile or usually pedunculate spikelets or glomerules of 3 to 6 or 8 sessile heads. Leaves silvery-white on both surfaces, crowded at the base of the branches, and often fascicled on short or stunted sterile branches, narrowly wedge-shaped, 1½–2 lines wide at the obtuse tridentate or trilobed end, narrowed down into a more or less distinct petiole; usually 3–6, rarely 8, lines long. Inflorescence interspersed with short and narrow, undivided, cuneate or spatulate obtuse leaves. Heads of flowers narrow, obovoid, nearly 1½ lines long, not much more than half as wide, with short and obtuse, canescent, exterior scales, and longer, scarious, interior scales, ciliate on the sides. Flowers in some specimens 3, in others often 4–5 in each head, all perfect, scarcely more than 1 line long ; ovary quite glandular and with the odor of turpentine.

This is the "Wild Sage" of Utah, and, perhaps, of the whole region west of the Rocky Mountains, where it seems to supplant the more eastern *A. cana*. Nuttall, who first described it, calls it a shrub about a foot high, and as such it appears in the mountains of Colorado ; but in Utah it is the largest and most abundant species, usually 2–4 feet high, rarely attaining a height of 6 feet, and then not straight, and with trunks of 3–6 inches in diameter ; sometimes the smallest bushes have trunks fully as thick as the tallest ones, short and chunky. East of the mountains, in the range of *A. cana*, it ever remains an inconspicuous shrub, lost among the more common species. Near Camp Floyd specimens were collected bearing white tomentose excrescences of the size of a pea, or larger, undoubtedly galls caused by the sting of insects ; the same have been observed on this species in Colorado.

The other species of *Artemisia* collected by the expedition were *A. Canadensis*, Michx., at Bridger's Pass ; *A. Ludoviciana*, Nutt., at Sweetwater, Bridger's Pass, Round Prairie, etc. ; *A. dracunculoides*, Pursh., on the Sweetwater ; and *A. frigida*, Willd., on the Upper Sweetwater River.

SARCOBATUS VERMICULATUS, *Torrey in Emory's Report* (1848), *p.* 149. *Batis* (?) *vermiculata*, Hooker, Flor. Bor.-Am. 2, p. 128 (1840). *Sarcobatus Maximiliani*, Nees in Pr. Maximil. Trav. Engl. ed. p. 518 (ex Torrey) ; Seubert in Bot. Zeitung, 1844, p. 753, cum tab.; Lindley in Hooker, Lond. Journ. Bot. iv. p. 1 (1845). *Fremontia vermicularis*, Torrey in Fremont's First Report, 1843, Rept. 1845, p. 95, and Fremont's Second Report, 1845, p. 317, [446]
tab. 3. *Sarcacanthus*, Nuttall in Pl. Gambel. p. 184. *Sarcobatus vermicularis*, Torrey in Sitgr. Rep. p. 169, in Stansb. Rep. p. 394, in Bot. Whipple, p. 130.[1] — *Pulpy Thorn* or *Pulpy-leaved Thorn* of Lewis and Clarke ; *Greasewood* of the present travellers and settlers.

This curious and important plant is found on the arid saline plains, principally on clayey soil, which in the wet season is moist, and on the border of salt-lakes, often covering large patches, from below Fort Pierre on the Missouri (*Dr. Hayden*) to the Upper Platte River (*Fremont, H. Engelmann*), and Upper Canadian (*Dr. James*) east of the Rocky Mountains to the plains of the Columbia (*Lewis and Clarke, Douglas, Fremont*), Utah (*Fremont, Stansbury*) through the Basin to Carson Valley (*H. Engelmann*) and down to the Gila River (*Emory*). Though discovered and noticed by

[1] Compare S. Watson's Revision of the American Chenopodiaceæ in Proc. Am. Ac. Arts Sc. vol. ix. p. 82 (1875).

Lewis and Clarke (1804) and collected by Dr. James (1819), this shrub was first described, 1840, by Hooker, in his North American Flora, from Oregon specimens, and was doubtfully referred by him to *Batis*. A few years later, it was again described by Nees, in his account of the plants collected by the Prince of Neu Wied, as a new genus under the name of *Sarcobatus*, and very soon afterward, and without a knowledge of the publication by Nees, again by Torrey under that of *Fremontia*. It is a great pity that this last name had to give way to priority; though at present a much handsomer and showy Californian shrub bears Fremont's name, the wide-spread *Greasewood* of the western mountains and deserts would more fitly have commemorated the bold and hardy pioneer of explorers to the millions who now do or in time to come will know and value this plant.

The GREASEWOOD forms a scraggy, stunted shrub, 2 or 3 to as much as 6 or 8 feet high; in Utah it is commonly 3–4 feet high. The stems are scarcely ever more than 1 or 2 and rarely 3 inches thick, knotty, flattened, twisted, and often with irregular ridges and holes (the scars of decayed branches); sometimes, however, many straight shoots issue from a single base, ¼–½ inch thick, so straight as to be used for arrows. They are covered with a compact, smoothish or slightly roughened, light-gray bark. The wood is very hard and compact, of light-yellow, in the core light-brownish, color, with very thin annual layers, in younger plants about ⅓, in older ones ¼, of a line or less thick. The oldest stems seen showed 20–25 rather indistinct rings, and were consequently so many years old. The numerous smaller branches have a smooth, shining, white bark, and are beset with white spines at right angles; these spines are indurated branches of two kinds. The sharper and shorter ones are real spines, scarcely ever more than ½–1 inch long; they bear leaves only, or, in the axils of these, female flowers, and are terminated by a sharp point and never by a staminate spike. The other spines are branchlets which did bear such a terminal spike, which, after flowering, has fallen away; they are 1–2 inches long, sometimes even longer, when they are apt to bear also lateral spines. The flower-bearing branches are very often secondary axillary productions closely under the sterile primary branch, which constitutes the spine, so that the spines often appear as axillary to the flower-bearing branches. The leaves are thick and pulpy, linear, or often narrowed toward the base, flattened or even slightly channelled on the upper surface, and [447] keeled on the lower one, at least toward the base, leaving a triangular scar after falling off. They are ½–1 inch, rarely as much as 1½ inches long, and ½ line, or sometimes, in the upper half, even 1 line, wide; in young and vigorous shoots, I have seen the leaves flatter, shorter, and broader, almost lanceolate. Their surface usually is perfectly glabrous; in specimens from Carson Lake, however, I find the younger leaves covered with a rough and sometimes branched pubescence. The leaves are sometimes on the lower part of the branches opposite, but commonly alternating in ⅖ order. The staminate and pistillate flowers are both very imperfect, but very different in their arrangement and structure; they usually occur on the same plant, though some plants seem to bear scarcely any but staminate, others only pistillate, flowers. The staminate flowers are crowded into a deciduous spike or ament, terminating the branches. This spike is, before the flowers open, 3–5 lines long and 1½ lines thick, and very compact, exhibiting only the rhombic surfaces of the scales; afterward it elongates to the length of 5–9 lines, showing the deciduous anthers under and between the separated scales. The spike consists of 25–35 peltate angular scales, pointed at the upper end, which cover 3–5 broadly oval anthers, sessile on the rhachis, ½ line long, 2-celled, opening laterally. The fertile flowers are usually solitary in the axils of the leaves and sessile; in some specimens I find a secondary flower just below the primary one, and sometimes even below a branch, springing from the same axil; sometimes they are aggregated on abbreviated branchlets, forming irregular clusters. The flower consists of a tubular calyx with an inconspicuous rim, investing the lower half of the ovary, which is terminated by two unequal subulate stigmas, lateral in regard to the stem. In the fruit, this rim is enlarged to a broad, circular, spreading wing, 3–5 lines in diameter, green or sometimes red, which surrounds the upper third of the fruit. The flattened vertical seed, enclosed in the membranaceous utriculus, is about 1 line in diameter, and contains a spiral embryo without an albumen, as already demonstrated and figured by Professor Torrey in Fremont's Report.

The Greasewood is found in flower from June to August.

The form from Carson Lake seems to be distinguished not only by the pubescence of the younger parts of the plant, but also by its more squarrose growth, its subdiœcious flowers, and its aggregated fertile flowers and fruits; but the Greasewood of other localities is also often subdiœcious, so that when first described it was considered a truly diœcious plant.

SPECIES IN GRAY'S BOTANICAL CONTRIBUTIONS (PROCEEDINGS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES).

Campanula leptocarpa, Engelm. in herb. (Specularia leptocarpa, *Gray*) and *C. intermedia*, Engelm. in herb. (Specularia biflora, *Gray*) [1876, xi. 82]. LESPEDEZA LEPTOSTACHYA, *Engelm. in herb.* [1876, xii. 57]. VERNONIA LETTERMANI, *Engelm. in litt.* [1880, xvi. 78].

IX. DESCRIPTIONS AND NOTES FROM THE BOTANICAL GAZETTE.

BAPTISIA SULPHUREA, *n. sp.* — Simple, with spreading branches, glabrous; leaves on very short petioles, [65] leaflets obovate, somewhat rhombic, obtuse or occasionally emarginate; stipules small, lanceolate, subpersistent; spikes rather short, with deciduous bracts, and sulphur-yellow spreading flowers; pedicels shorter than the broad campanulate calyx; broad ovate acutish teeth, shorter than tube, woolly inside; style much longer than oval ovary (5 lines long); stipe of globose pod exsert.

Prairies, Tabaksi County [Indian Terr. *G. D. Butler*], rare, flowers in May. *B. leucantha* differs by its larger growth, deciduous stipules, longer spikes of white flowers which open much later, and longer pedicels, short style (3 lines long) about as long as the linear ovary. *B. sphærocarpa* is well distinguished from our new species by its cæspitose growth, more erect branches, strict spikes with erect deep yellow flowers, pedicels shorter than calyx, the lobes of which are triangular lanceolate, very acute, as long as the narrower tube, and sparingly woolly inside; style much longer than the oval ovary (6 lines long); stipe of pod scarcely longer than calyx. The new species is so much intermediate between the two just mentioned that it suggests the idea of hybridity. — [1878, vol. iii.]

CATALPA SPECIOSA, *Warder.** — A middle-sized tree, with grayish-brown, much cracked or furrowed, at last [1] slightly flaky bark, and light, yellowish-gray wood; leaves large, truncated or more or less cordate at base, slenderly acuminate, soft downy on the under side, inodorous; flowers in large and loose panicles; tube of the corolla conical, longer than wide, its lower part scarcely protracted; upper lip before its expansion longer than the other lobes and enveloping them, lower lobe bilobed, inside of corolla slightly marked at the throat with red-brown lines [2] and with two yellow bands at the commissures of the lowest with the lateral lobes; stamens and style as long as the tube; pod terete, strongly furrowed; wings of seed about as long as the seed itself, rounded at the ends and split into a broad coma.

Common in the low, rich, sometimes overflowed woodlands near the mouth of the Ohio, along the lower course of that river and its confluents, and in the adjoining lowlands of the Mississippi; in the States of Illinois, Indiana, Kentucky, Tennessee, Missouri, and Arkansas; according to Michaux abounding near the borders of all the rivers which empty into the Mississippi farther south; whether the localities, cited by him, of West Florida produce this or the Eastern species, is at present unknown. — Flowers in May. — This tree has quite an interesting and instructive history. It was already known to Michaux and to many botanists and settlers of those regions; even the aboriginal Shawnees appreciated it, and the French settlers along the Wabash named it for them the Shawnee wood (Bois Chavanon), and prized the indestructible quality of its timber; but the botanists, even the subtle Rafinesque, who roamed over those very regions, seem to have taken it for granted that it was not distinct from the Southeastern *Catalpa bignonioides*. To me the fact that these trees, then not rarely cultivated in St. Louis,[1] produced their larger and more showy flowers some 10 or 15 days earlier than the Eastern or common kind, was well known as early as 1842, and their blossoming has since been annually recorded in my notes on the advance of vegetation, but I had not the sagacity or curiosity to further investigate the tree. It was reserved to Dr. J. A. Warder, of Cincinnati, to draw public attention to it. He was struck with its beauty in the streets of Dayton, Ohio, where a few stragglers were cultivated, and described it cursorily in his journal, the Western Horticultural Review, vol. iii. p. 533, without deciding whether a distinct species or a variety, and without assigning a name to it. It was soon named, however, privately as it seems, by him and his friends, *Catalpa speciosa*, and was propagated as a more ornamental form. Thirteen years later I find in the catalogue of J. C. Teas's nursery, Baysville, Indiana, for 1866, *Catalpa speciosa* offered, the 100 one-year old seedlings for $1.50. But only within the last few years the beauty and importance of the tree has made a greater impression on the public mind, principally through the exertions of Dr. Warder himself, Mr. E. E. Barney, of Dayton, and Mr. R. Douglas, of Waukegan, Ill. The latter was so much struck with the future importance of this species that in the autumn of 1878 he collected on the lower Ohio 400 pounds of its seed for his own nursery and for distribution to all parts of the world.

Catalpa speciosa replaces *C. bignonioides* entirely in the Mississippi valley. It is readily distinguished from it by its taller and straighter growth, its darker, thicker ($\frac{1}{2}$–1 inch thick), rougher and scarcely exfoliating bark (in the older species it is light gray, constantly peeling off and therefore not more than 2 or 3 lines thick); its softly downy, slenderly acuminate and inodorous leaves (those of *bignonioides* have a disagreeable, almost fetid odor when [3] touched), marked with similar glands in the axils of the principal veins of the under side; by its much less crowded panicle and by its much larger flower, fruit, and seed. The flowers I found 2 inches in the vertical, and a little more in the transverse diameter; in the other they have $1\frac{3}{8}$ inches in each diameter; the lower lobe is deeply notched

* Reproduced in the Gardener's Monthly, April, 1880, pp. 116–118. — EDS.

[1] It seems singular that the common Eastern species has in our streets almost completely supplanted the much handsomer native.

or bilobed in *speciosa*, entire in *bignonioides;* the tube in the former is conical and 10 lines, in the latter campanulate and about 7 lines long; in the first slightly oblique, in the other very much so, the upper part being a great deal shorter than the lower one, so that the anthers and stigma[2] become uncovered; the markings in the flower of the old species are much more crowded and conspicuous, so as to give the whole flower a dingy appearance, while ours looks almost white. The upper lip of the corolla before expansion extends beyond the other lobes and covers them like a hood in the Western species, while in the Eastern it is much shorter than the others and covers them only very partially. The pods of our species are 8–20 inches long, 17–20 lines in circumference, dark brown and strongly grooved when dry, the placental dissepiment very thick; in the Eastern species the pod is nearly the same length, but only 9–12 lines in circumference, its grooves very slight, its color pale, and the dissepiment flat. In both species the pod is perfectly terete before the valves separate, after that the valves of ours remain more or less semiterete, while the much thinner ones of the other flatten out, so that they *seem* to indicate a compressed pod. The elongated seeds, winged at both ends, are of about equal length in both species, but in *speciosa* they are much wider (3½–4 lines) and the wings have more or less rounded ends which terminate in a broad band of rather short hair; in *bignonioides* the seeds are only 2½–3 lines wide, with pointed wings, and their tips terminating in a long, pencil-shaped tuft of hair.

Our tree is larger, of straighter growth, and being a native of a more northern latitude, is hardier than the Southeastern species; the wood of both is extremely durable, perhaps as much so as that of our red cedar, and has the advantage over it of a much more rapid growth, and of possessing only a very thin layer (2 or 3 annual rings) of destructible sap wood. But of these qualities, and of its adaptability to many important uses, others, and especially Mr. Barney in a recent pamphlet, have given a full account. It is already extensively planted in our Western prairie States, and especially along railroads, for which it is expected to furnish the much-needed timber in a comparatively short time.*—[1880, vol. v.]

FRAXINUS QUADRANGULATA has, at least about Allenton, in St. Louis County, Missouri, hermaphrodite [63] flowers. Mr. G. W. Letterman finds it there common on rocky hills where it is a small tree or shrub with blunt angles of the branchlets, and in rich bottom-lands, where the tree is large, and the angles of the branchlets sharp, and even winged. Leaves are sometimes in threes when the branchlets show six angles. The terminal buds are gray-downy. In both localities the flowers are hermaphrodite. The calyx is practically absent, or indicated only by two obscure knobs or two minute scales, alternating with the stamens; the anthers are sessile and (before opening) reniform, their two cells being united above; stamens somewhat persistent at least to the beginning of May, when the young obovate-oblong fruits, already somewhat twisted (which twist is more marked in the mature fruit), have reached about half their full size. How does the species behave in other parts of the country? The style of *Fraxinus Americana* is very slender — much longer than the ovary; that of *F. viridis* does not much exceed the ovary. —[1880, vol. v.].

[2] I may here remark that *Catalpa*, probably like all its allies, is proterandrous, the anthers open in the morning and the lobes of the stigma separate and become glutinous towards evening, the upper lobe remaining erect, the lower turning down close upon the style. I have not ascertained how they are impregnated, as at that time the anthers are effete, and by the following morning the lobes of the stigma are again closed.

* At the meeting of the St. Louis Academy of Science, Jan. 19, 1880, Dr. Engelmann stated that "a native Catalpa was found growing in Southern Illinois, Indiana, and Southeast Missouri, and was called 'Shawnee wood' by the early French settlers, on account of its use by the Shawnee Indians. Michaux knew this tree ninety years ago without distinguishing it from the old species found in Georgia. Forty years ago a number of them were growing on Main and Second Streets, in the gardens of Chouteau and the Catholic Bishop, and a few are still standing on Third Street, near Plum, and others in different parts of the city. This variety is botanically different from the majority of Catalpas found in the city now. It is of larger growth, with larger and more showy blossoms, and it blooms from one to two weeks earlier. In the forests of Missouri it attains a height of sixty feet; the trunk is straight, and it is altogether a most beautiful tree. New Madrid is the centre of its geographical distribution. It grows rapidly, and is almost indestructible in water. Gate-posts on the farm of the late President Harrison, in Indiana, have been standing for eighty years. The wood admits of a fine polish, and the sap-wood becomes heart-wood in two or three years, whereas it takes the cedar twenty-five years to attain its durable quality. No better wood could be found for railroad ties if the wood turns out to be solid enough to bear the shock, and the railroads are already preparing to use it for this purpose. It should be planted on our prairies, where it would be found a most valuable tree for many purposes." — *Transactions*, vol. iv. 1882, *Journal of Proceedings* 1].

In a notice of Brooks's wood sections (Bot. Gazette, vol. viii. 1883, p. 338), Dr. Engelmann states that "in a hasty examination of the specimens, catalpa wood is found with a few accessory lines which might readily be mistaken for annual rings but for the want of the pores always accompanying the vernal wood in this genus. Such accessory rings (false annual rings) are rare in the woods of our temperate climate, but in a specimen of *Pinus Elliottii*, of South Florida, I find such rings quite numerous, and difficult to explain and to distinguish from true annual rings. In wood of the same species from farther north no such appearance is observed, the annual rings being clear and well marked." — EDS.

Some Additions to the North American Flora.

Dicentra ochroleuca, *n. sp.* Stem erect, 3–4 feet high, leafy, leaves glaucous, large (lower ones a foot [223] or more long), 3-pinnate, ultimate divisions deeply cleft into lanceolate-linear lobes; flowers panicled on very short pedicels, about 15 lines long, ochroleucous; membranaceous sepals suborbicular; exterior petals slightly saccate at base, upwards narrower, somewhat concave below the acute tip, and scarcely spreading; inner petals widened above into a deep purple circular tip, crested with two very broad flat and elongated appendages; stamens subulate scarcely cohering.

In valleys of the Santa Monica Mountains near Los Angeles, Cal., where it grows with the rather rare *Ceanothus spinosus*, the rootstock of which, named red-wood, furnishes the principal firewood there. — Together with *D. chrysantha* this handsome species constitutes the subgenus *Chrysocapnos*, in which the crest, single and inflated in the true *Dicentræ*, is formed of two distinct lamellæ, flat and large in our species, short and curly in *D. chrysantha*. This latter is a coarser plant with much smaller golden yellow flowers (6–9 lines long) and deeply concave, spreading outer petals.

Tsuga Caroliniana, *n. sp.* [supra, p. 382]. T. Canadensis [*l. c.*]. T. Mertensiana [*l. c.*]. Yucca [224] macrocarpa, *n. sp.* [supra, p. 299]. Juncus rugulosus, *n. sp.* [supra, p. 275]. [225] Monanthochloë littoralis [supra, p. 500]. — [June, 1881, vi.]

Eschscholtzia Californica. The different forms of this common and extremely variable plant deserve [235] to be studied more carefully at their homes, where they are found in such untold abundance. It is quite possible, as indicated in the Flora of California, that the several species into which it had been divided, may be sustained by reliable characters. All the forms, however, are said to be annuals with colorless juice. Now, on the sandhills of the ocean, quite close to the well-known Cliff-house near San Francisco, I found last October a form with long perennial roots, ½ inch thick, abounding in orange-colored juice, and bearing several stems; leaves shorter than the internodes, often opposite, flowers 1 inch wide; torus broadly margined, capsule about 2 inches long, seeds reticulated. In most respects it represents the typical form of *E. Californica*, but the perennial rootstock seems to [236] distinguish it; annuals, to be sure, in mild climates not rarely last for several years, e. g. *Solanum nigrum* in Southern California, but in these the stem becomes ligneous and no rootstock forms, the normal tap-root not losing its characters, even if it does become 3 or 4 years old. It is barely possible that *E. Californica* is one of those perennials which will flower as seedlings in the first years, and that then the aridity of the climate in many instances kills it, root and all; but if so, why has this occasionally (?) perennial character not been observed before?

Portulaca suffrutescens, *n. sp.* — Erect, about a span high from a stout, branching and apparently perennial rootstock, ligneous at base; leaves terete, about 1 inch long, with sparingly hairy axils; flowers clustered at the end of the branches, large (7 to 10 lines wide), yellowish buff-colored; petals obcordate or emarginate; stamens numerous; filaments, like the 5 or 6 stigmas, red; seeds dark, with metallic lustre, tuberculate.

In Western New Mexico, at the copper mines, *C. Wright*, 874, coll. 1851; *Coues & Palmer*, Fort Whipple, Northern Arizona, 1865; found by myself, 1880, on rocky banks in the Santa Rita Mountains, Southern Arizona.

Very near *P. pilosa*, with which I had formerly united it; the seeds of both are similar, their tubercles, magnified 40–60 diameters, appear very prettily as overlapping excrescences with a toothed free edge; both have dark seeds, ours with a metallic lustre, the others more dull. The number of stamens in different flowers was about 40; while in *P. pilosa* it is stated to be 15 to 25, but in cultivated specimens of the latter I have found as many as 50! The color and size of the flower, the larger leaves with sparing hair in the axils, and the stouter stems and perennial (?) rootstock distinguish it from its purple-flowered annual relative.

Rosa spithamea, *Watson, Fl. Cal.* 2, 444. — In the deep shade of the Big Trees of Fresno County, Cal., where scarcely anything else grows, I found what I take to be a form of this pretty little species, blooming in September. I may designate it as

Var. subinermis: stems a span high, glabrous or more or less glandular hispid, with a few scattered setaceous spines (none stipular) or spineless; stipules short and narrow with short narrow divaricate free points; leaflets mostly 5, thin, pale below, elliptical or nearly orbicular, obtuse, sharply serrate and glandular serrulate; rhachis glandular-pubescent and often spinulose, petiolule of terminal leaflet almost its own length; flowers single (1¼ to 1½ inches wide) rose-colored; peduncle slightly glandular, calyx tube globose, naked, lobes entire.

The stems of the same season bear the flowers, as is the case in *R. foliolosa* of Texas; or is it in this instance an autumnal form? There may be characters enough, especially the absence of any stipular spines, to distinguish specifically this southern form from the northern type, but considering the great variability of roses it is thought best to keep them together for the present.

The western roses, and to some extent all our roses, are in some confusion and what my cursory visit to [237] the Pacific coast may have done to clear them up is offered here.

ROSA NUTKANA, *Presl*, is common in Oregon and northward, but I have not met with it in California ; it is characterized by very broad and stout stipular and cauline spines, which are particularly abundant on annual shoots, and by large single flowers and large globose or depressed fruit. *R. Durandii*, Crepin, from Oregon, appears to be a form of this species with glandular calyx tube, which in the type is glabrous.

ROSA PISIFORMIS, *Gray*, stands next to this and not to the following. Like it, it has well-developed stipular spines, but they are slender and more terete ; corymbs few-flowered, fruit smaller ; young shoots mostly densely covered with dark red-brown slender spines and spiny bristles, by which the plant can be distinguished at any time, even without flower or fruit. I found it from British Columbia down to the neighborhood of San Francisco and Monterey.

ROSA CALIFORNICA, *Cham. & Schl.*, a bush often 4–5 feet high, along streams, bears its flowers in large compound corymbs ; its annual shoots are glaucous, covered with stout straight or often curved or even hooked glaucous spines ; form of fruit variable, oblong or globose, with a more or less distinct contracted neck. — Common about San Francisco, thence northward to the Klamath River and southward to Los Angeles and San Bernardino.

ROSA GYMNOCARPA, *Nutt.*, in the rich woods of the Oregon Coast Ranges, with stems 1½–2 inches thick and 8 feet high, otherwise mostly a slender bush ; annual shoots densely covered with glaucous or gray bristly spines ; distinguished from all other roses, I believe, by its naked fruit (globose or elongated, sometimes pointed at both ends), from which after flowering the *united* calyx lobes separate, bearing at their base the stamens.

CAMPANULA SCABRELLA, *n. sp.* — Several leafy stems from a stout rootstock, a few inches high, 1 to several-flowered, the whole plant canescently scabrous with very short rough pubescence; lowet tufted leaves spatulate, obtuse, attenuated below, stem leaves sessile, lanceolate, acutish ; flowers erect, lance-linear lobes of calyx as long as tube ; ovate-lanceolate lobes of corolla as long as its tube, scabrous outside ; style shorter than corolla ; capsule erect, oblong, 10-angled, opening near the upper edge.

On bleak rocky ridges of Scott Mountain, west of Mount Shasta, under scattered trees of *Pinus albicaulis* and *P. Balfouriana* with *Anemone Drummondii*, Wats.,[1] *Veronica alpina*, *Polygonum Davisiæ*, and the charming *Epilobium obcordatum*, in August. The thick tap-root penetrates 3 to 5 inches between the fragments of rock; lower leaves 1 inch long, the upper not much shorter; branches strictly erect, peduncles naked, flowers nearly ½ inch [238] long.

Distinguished from the closely allied *C. uniflora* by the habit, the canescence, and the form of the capsule. Careful study of abundant materials proves that *C. uniflora* will have to comprise all the forms from Colorado and Utah which have been named *C. Langsdorffiana* or *C. Scheuchzeri*, among them the specimens of Parry and of Hall with denticulate calyx lobes, and similar ones gathered by myself; they have erect elongated capsules tapering below, opening near the top; corolla divided nearly to the middle, often 1 inch wide ; stems 3 to 4 or 8 to 10 inches high, 1 to 4-flowered. True *C. Scheuchzeri* (or *linifolia*) comes from Alaska ; its corolla lobes are short, ⅓ or less of the tube, the short ovate capsule is nodding and opens at base. The confusion arose in great part from the carelessness of collectors, who are mostly satisfied with nice flowers and neglect the less conspicuous fruiting specimens. Among several dozen specimens from the Rocky Mountains and Alaska, gathered by different collectors, I find only few with the characteristic capsules, and these I collected myself. Fruit and seed are such important organs that they ought always to be hunted up, and of every plant ; this necessity is well known in *Compositæ* and *Umbelliferæ ;* but it is true of all plants, and ought to be well borne in mind by collectors. Such neglect is one of the causes why the species of *Vitis* and especially the *Cactaceæ* were not better understood long ago. — [July, 1881, vol. vi.]

STELLARIA OBTUSA, *n. sp.* — Glabrous, stems weak, prostrate, much branched, leaves subsessile, triangular- [5] ovate acute, smooth-edged 1-nerved and the delicate reticulated veins uniting into distinct intramarginal nerves ; flowers single, pseudo-axillary, peduncles nearly as long as the leaves patulous or recurved in fruit, sepals ovate obtuse nerveless scarcely membranaceous on the margin, petals (always ?) wanting; capsule ovate obtuse scarcely exsert, seeds (under the lens) covered with oblong linear pectinate tubercles, dark brown. — Western Colorado on the tributaries of Gunnison River, alt. 9,000 to 10,000 feet, in damp grounds, *T. S. Brandegee*. Closely allied to *S. crispa* of the northwest, but readily distinguished by the form of the sepals, the capsule and the seeds; in that species the sepals are lanceolate, broadly margined and 3-nerved, the capsule exsert, acutish, the seeds larger, reddish and nearly smooth. *S. borealis*, with which *crispa* has sometimes been united, has a similar calyx, capsule and seeds, but is distinguished by its elongated lance-linear leaves, finely serrulate on the edge, the intramarginal nerve very indistinct.

CAMPANULA PLANIFLORA, *n. sp.* — Erect, glabrous, a finger to a span high from a filiform rootstock bearing similar subterranean stolons, usually 1-flowered ; leaves lanceolate to linear-lanceolate 1 to 2 inches long, 2–3 lines

[1] Well distinguished from *A. multifida*, not only by its larger fruit and long style, but also by the oval, not circular, outline of the more finely divided leaves, the terminal division of which is long stiped, not sessile.

wide, the lowest ones sometimes broader, all more or less dentate or denticulate ; flower erect, calyx turbinate, lobes lance-linear mostly dentate, several times longer than the tube and exceeding the tube of the corolla ; corolla shallow, wide open, 4 times wider than deep, divided to the middle or beyond ; lobes ovate acute spreading or at length reflexed ; capsule erect ovate or turbinate as long as the connivent calyx lobes or shorter, opening at top. — *C. Langsdorffiana* of the Rocky Mountain floras, not Fischer ; *C. Scheuchzeri*, Gray Flora in part.

Common in subalpine meadows, near streamlets, at an elevation of 7,000–9,000 feet, Colorado ; Clear Creek valley, Middle and South Parks. The large and very shallow flowers of a reddish-purple color and the filiform branching rootstocks distinguish this species at once from *C. uniflora* with which I had united it (this journal, 6, 238). The usually erect stems become sometimes decumbent and several-flowered when overgrown. *C. uniflora* is found only on bare alpine slopes, usually with *Dryas* and *Silene acaulis*, at about 12,000 to 13,000 feet alt. It grows from a stout several-headed rootstock, bears deeply campanulate mostly horizontal flowers ½ inch in length and [6] an erect fruit ; the leaves are usually marked with a few small glandular semi-transparent teeth in notches.

ERIOGONUM ALPINUM, *n. sp.* — Few heads from a very stout caudex ; the whole plant (except the flowers) densely white tomentose ; leaves nearly orbicular, 1 inch wide, attenuate at base into a petiole of the same length ; scape (about 4 inches high) with a verticil of 3 or 4 lanceolate, foliaceous bracts above its middle ; umbels solitary, involucrum broadly campanulate (3 lines wide) with 9 to 12 short, erect teeth ; flowers very numerous, attenuate at base, glabrous in and outside, yellow, 2½ lines long. — On Scott Mountain, Northern California, together with *Campanula scabrella* (see page 237) on stony ridges about the timber line, *G. E.* The large single yellow heads look very much like those of some alpine composite ; the plant is a counterpart to the glabrous rose-flowered *E. pirolæfolium*, Hook., found on the opposite Mount Shasta in similar situations.

JUNCUS CANALICULATUS, *n. sp.* [supra, p. 275]. — [1882, vol. vii.]

THE BLACK-FRUITED CRATÆGI, AND A NEW SPECIES.

We know within the limits of our flora of two black-fruited *Cratægi*, both from the western half of the [127] continent. Mr. G. W. Letterman has now discovered a third one along Red River. These three species may be distinguished from our ordinary red-fruited ones, to be designated as Sect. *Erythrocarpus*, as Sect. *Melanocarpus*, and may be characterized by their black or black-purple or bluish fruit ; leaves, at least at first, appressed hairy [128] on the upper and glabrous on the under side ; flowers in corymbs, styles usually 5 ; spines mostly short and stout, often recurved. The three species are : —

C. DOUGLASII, *Lindl.*, the westernmost species, from British Columbia to California, with broader, thinner doubly serrate leaves, the upper ones on the shoots lobed, and with broad, incised-toothed stipules ; calyx lobes usually entire ; fruit smaller, black-purple, ripe (in Northern California) in August ; nutlets 2 to 3 lines long, strongly ridged on the back ; spines ½ to 1 inch long.

C. RIVULARIS, *Nutt.*, in the Rocky and Wahsatch Mountains of Colorado and Utah, with narrower, more rigid, lanceolate-ovate, singly serrate leaves, only the upper ones of the shoots broader, doubly serrate or rarely slightly incised, with narrow glandular-incised stipules ; calyx lobes usually glandular ; fruit larger ; nutlets 3 lines long or over, usually strongly ridged on the back ; spines few, ½ to 1 inch long.

C. BRACHYACANTHA, *Sargent & Engelm.* A tree 20 to 30 feet high, or sometimes larger, with smoothish or, in very old trunks, rough bark ; spines on the whitish branches numerous, stout, short (3 to 6 or 8 lines long), mostly curved, sometimes terminating the branches ; leaves lanceolate-oblong to ovate or rhombic, 1½ to 2 or 2½ inches long, attenuate into a short petiole, thick and almost coriaceous, appressed-serrate, shining, with ribs almost obliterated, those of the terminal shoots larger, broader, slightly lobed, with large foliaceous dentate or subentire stipules ;[1] flowers small for the genus, with broadly lanceolate entire calyx lobes and 5 styles ; fruit depressed globose, about ½ inch through, black-blue with bloom ; nutlets (3 lines long) with two slight grooves on the nearly smooth back.

In the Red River region, first collected by *Drummond* (Louisiana Coll. 1832, No. 105 in part) ; Webster Parish, La., *C. Mohr*, 1880, both without flower or fruit ; Concord, Texas, *C. S. Sargent*, March 29, 1881, with flower buds ; west of Longview, Texas, *G. W. Letterman*, Aug. 19, 1882, with mature fruit, "they looked from a distance like plum trees with small blue fruit, the ground under them was covered with the fallen haws." The species is easily recognized by its coriaceous, shining, almost ribless leaves ; in *C. Douglasii* they are broader, membranaceous, and dull, in *C. rivularis* intermediate between the two.

I may add here that Prof. Sargent rediscovered the obscure *C. berberifolia*, Torr. & Gray, which was founded on a single flowerless specimen, in the very region, near Opelousas, Western Louisiana, where Dr. Carpenter [129

[1] The stipules of *Cratægus* are not often noticed, and I am not sure that they possess much constancy or diagnostic value. Generally they are found only or at least are most persistent on the shoots ; they are always oblique and petioled or stipulate, broadly triangular to linear, mostly incised-dentate or sometimes glandular-dentate, rarely entire.

first collected it about 50 years ago; it is a small tree with dark ash-gray branchlets bearing numerous long (1½ to 2 inches long) stout, straight spines; leaves spathulate or obovate, obtuse, attenuate into a short petiole or almost sessile, simply serrate towards the upper part, ¾ to 1½ inches long; those of the shoots similar or acutish, often doubly or incisely serrate or slightly lobed, with linear glandular stipules, all persistently pubescent; compound corymb woolly; flowers large, calyx lobes linear, entire; styles 3; fruit unknown. — [Nov. 1882, vol. vii.]

PLANTAGO PUSILLA, *Nutt.* — The ordinary form of Missouri and Illinois, where it is common, and as far as [175] I can see of the Eastern States, where it is much rarer, has linear or filiform entire leaves, scapes 2 to 4 or rarely 6 inches high, obtusish or subacute bracts of the length of the orbicular sepals, and short oval slightly exsert capsules, 4 seeds, about 1.3 mm. or 0.6 line long.

Var. MACROSPERMA is a larger form, 4 to 7 inches high, with longer, much exsert capsules; seeds nearly twice the length of the last, 2.4 mm. or 1.2 lines long. — Saline soil of the western plains; on the Cheyenne River, *Nicollet*, and near the mouth of the Yellowstone River, *Hayden*.

Var. MAJOR, much larger and stouter, leaves lanceolate-linear, often 1½ to 2 lines wide, the larger ones laciniate with few long teeth or lobes; scapes densely woolly at base, with the elongated spike often 9 inches high; bracts acute, longer than the sepals; seeds intermediate in size between the two other forms. — Near Atoka, north of Red River in the Indian Territory, *G. D. Butler*.

Dr. A. Gray thinks that he has proofs that this species, or probably the second form of it, is the lost *P. elongata*, Pursh, Fl. Suppl. p. 729, but even if so, Nuttall's name, now well known since more than 60 years, [176] ought to be retained in place of a doubtful and very inappropriate one. — The three closely allied species, *P. Bigelovii* and *P. pusilla* with 4 seeds, and *P. heterophylla* with numerous ones, have all pitted seeds, well seen only in perfectly mature specimens. The seeds become gelatinous when wet. — [Feb. 1883, vol. viii.]

MORPHOLOGY OF SPINES.

In an illustrated paper lately laid before the German Botanical Society, Dr. I. Urban, of Berlin, proves [338] that the spines of *Aurantiacæ* are not, as has been generally assumed, abortive branchlets, such as we find in *Cratægus*, *Gleditschia*, and many other ligneous plants. He shows that they are the abnormally developed basal leaves or bud scales of the axillary bud. A pair of these scales is found on both sides of the bud; sometimes both of them are developed into spines, and then the small bud itself is found between and a little above them. In other cases the scales are unequally developed into a small and a larger spine, but more frequently only one of them grows out into a spine. In this latter case the spine assumes an almost axillary position, and the rest of the bud, with the other lateral (originally opposite) minute scale, is pushed sideways and upwards, so that it assumes the position generally ascribed to it by those who have treated on this subject, seemingly above the spine, thus simulating a secondary bud above the primary one, which would be the spine. But the bud will always be found a little sideways of a line drawn from the centre of the axil upwards, and the other lateral bud scale can always be discovered on the other side of the bud. Where there are a pair of unequally developed spines the case becomes quite plain.

In connection with this and other strange developments of different organs into spines, it occurred to me that my observations on the morphology of the spines of *Fourquiera*, made nearly thirty years ago, seem to have escaped botanists; though I have often spoken of them, I have never published anything about them.

A small specimen of *Fouquiera splendens*, sent to me from New Mexico, vegetated well enough for many months, continuing to make its fasciculated spatulate subsessile leaves from the undeveloped branchlets in the axils of the spines, without showing any further growth, till after a heavy thunderstorm and rain with sultry weather, a vigorous shoot sprang suddenly from one of the uppermost of these axils and developed scattered leaves of the same form, but larger, and borne on long (say ½ inch long) horizontal petioles, while the leaf-blade was nearly erect. In the fall these leaves began to wither and to fall, but not, as one might have expected, at the insertion of the [339] petiole on the axil, nor at the junction of the blade with the petiole; the withered upper half of the petiole separated from the persistent indurated under part in a diagonal plane, so that this indurated part was stoutest at its insertion on the axis, and ran out into a sharp point, while the deciduous part of the petiole was thickest at its connection with the blade, and fell off with it, leaving a spine which persists as long as the stem does, and which from its axil produces the short spurs with their fasciculated leaves mentioned above. The formation of these different axes and their leaves resembles that of *Larix*, but the morphology of the spines is, as far as I know, quite unique.* — [1883, vol. viii.]

* This was noted by Charles Wright, long ago. See Plantæ Wrightianæ, ii. 63. — EDS.

X. DESCRIPTIONS FROM THE BULLETIN OF THE TORREY BOTANICAL CLUB.

CRATÆGUS ARBORESCENS, *Ell.*, is not uncommon in the rich alluvions of the Mississippi River, near St. [4] Louis, and probably inhabits the banks of this river and its lower tributaries down to its mouth. It has not been recognized of late, and seems to be quite rare in herbaria, and is probably not in cultivation. I have not much to add to Elliott's, Torrey and Gray's and Chapman's descriptions, but may say that in this neighborhood it is the largest species of the genus, making trunks from 8–12 and, as Mr. Eggert informs me, even 18 inches in diameter, 5–7 feet high, fluted or grooved, and with a broad top, rarely bearing any thorns. The leaves, cuneiform at base, undivided or, at the end of the shoots, 3-lobed, resemble in form those of *C. tomentosa*, but are smaller, much thinner and smoother, even when young, often with soft down in the axils of veins underneath; flowers in loose corymbs, only 7 or 8 lines wide; calyx smooth, neither pubescent nor glandular, with triangular acute lobes; styles 5; drupes depressed-globular, 4–5 lines thick with 5 (or rarely more) stones grooved on the back, light red or rarely orange-colored, persisting through winter, when those of our other species, *C. coccinea, Crus-galli, subvillosa*, and *tomentosa*, drop off.— [Jan. 1882, vol. ix.]

ROSA MINUTIFOLIA, *n. sp.* — A much-branched shrub, 2–4 feet high; shoots pubescent, densely covered [97] with straight or slightly curved, red-brown, bristly, at first pubescent spines, their leaves with broad, divaricately auricled stipules, and mostly 5 leaflets; fertile branches bearing numerous terete, subulate spines, some of the shorter and more persistent ones often in pairs under the branchlets; leaves fasciculated on short spurs, narrow stipules divaricately auricled, leaflets minute (only 1–2 lines long, the lowest pairs the smallest) oval, simply incised-dentate, pubescent, not glandular; flowers single, ¾–1 inch wide, on tomentose, bractless peduncles from between the leaves; calyx-tube globular, densely setose-hispid, a thick nectariferous ring contracting its opening; petals suborbicular, scarcely emarginate, deep rose-purple or white; central ovules borne on short stipes; styles distinct, short, woolly.

Described from specimens sent by Dr. C. C. Parry and M. E. Jones. A most striking and lovely species, distinguished from all other roses by its minute, deeply incised leaflets. The young shoots have larger, distant leaves, with fewer, but larger leaflets, the terminal one the largest, sometimes 4 or 5 lines long; fragrance faint. This species is quite peculiar among its American congeners, and even among the roses of the Old World, so that it is difficult to determine its true position. In aspect and habit it comes nearest to the *Pimpinellifoliæ* on account of its single [98] bractless flowers, its numerous acicular spines, and its small leaves; but it recedes in its pinnatifid calyx-lobes. — [Aug. 1882, vol. ix.]

Through the kind exertions of Miss F. Fish of Sauzal, mature fruit of this interesting species, described in [127 the August number of the BULLETIN, has been obtained and is being widely distributed, so that we may hope soon to see it in cultivation. The fruit is globose, crowned with the persistent erect calyx-lobes, deeply red-brown, bristly-hispid; seeds generally few, bearing the woolly, at length deciduous style.

In the description of the flower it ought to have been mentioned that the outer calyx-lobes are pinnatifid, which however is alluded to at the end of the article. The locality is Sauzal, not Sanyal, as printed. — [Oct. 1882, vol. ix.]

FROM WATSON'S LIST OF PALMER'S PLANTS COLLECTED IN S. W. TEXAS AND NORTH MEXICO (PROCEEDINGS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES, VOL. XVIII. 1883).

EPHEDRA PEDUNCULATA, *Engelm. mss.* E. ASPERA, *Engelm. mss.* [157]

XIV.

GENERAL NOTES.

I. ON THE CHARACTER OF THE VEGETATION OF SOUTHWESTERN TEXAS.*

From the Proceedings of the American Association for the Advancement of Science, Vol. V. 1851.

The Flora of the immense territory of the United States bears a peculiar common char- [223]
acter, distinguishing it from other regions of vegetation. This character consists in the prevalence of some families and more especially of the *Compositæ*, of the occurrence of others only in this part of the globe (e. g. *Magnoliaceæ*), and in the great number of species of many genera known in other countries only by a few living representatives or among the fossil remains of the brown coal (tertiary) formation. Such genera are the oaks, the pines, the horse-chestnuts or buck-eyes, the maples, the grapevines (*Vitis*), the birches, the walnuts and hickories. The magnolia, the Gleditschiæ, and the sweet gum (*Liquidambar*) are in Europe only found among the fossils. Herbaceous plants exemplifying this character are the asters, Solidago, Helianthus, Asclepias, etc.

But as we may naturally infer, this large territory shows different regions of vegetation, produced or influenced by climate, conformation of the surface, geological character of the soil, and perhaps other causes not so readily appreciable.

Such different areas are the northeastern Alleghanies and their slope to the Atlantic; the southern part of that mountain range and its eastern slope to the ocean; the subtropical region of Florida, so different from that of Texas though in the same latitude; then the western slope of the Alleghanies towards the immediate valley of the Mississippi; the northern and the southern part of that valley itself, the latter including Northeastern Texas; again the region of the Western plains and deserts; that of the Rocky Mountains, of the Pacific coast, and finally the peculiar flora of Southern Texas, or of the Rio Grande valley.

Though I have never explored that country myself, the extensive and beautiful collections of my friend Ferdinand Lindheimer, together with his very full notes, enable me to attempt a sketch of the character of that flora.

And I here take the liberty of again reminding you of a remark made from this place a day or two ago by one of our highest authorities, in speaking of palæontological collections, and which cannot be too often repeated and inculcated; that is, it is not only the collected specimen itself, which is valuable, but the notes, the data in regard to exact locality, association with other forms, and all circumstances tending to enlighten us in regard to it, are absolutely necessary to give [224]
to the specimen its full value.

Southwestern Texas, as I regard it, to judge by the character of its vegetation, has its natural boundaries to the northeast on the Brazos, or more properly between this and the Colorado River; to the southeast in the alluvial plains which extend from the Gulf coast into the interior, and which bear more the character of a subtropical vegetation; to the south and southwest by the Rio

* See also an account of the western part of Texas in Boston Journal of Natural History, vol. vi. 1857, pp. 34–40. — Eds.

Grande, or most probably by the northern slope of the Mexican table-land southwest of that river; and to the northwest by the mountains and plains of New Mexico.

The geological character of this country is well known through the investigations of Prof. Roemer, to which the notes of Lindheimer and others have added some details. The whole of this country, with slight exception, is of cretaceous formation; the rocks are calcareous, with cherty mixture, and of horizontal stratification, rising in several plateaus or terraces one above the other, over the alluvial lands of the sea-coast; the plateaus often with steep declivities, and not rarely broken up into level topped hills with terraced slopes. The rivers and brooks are clear streams often with wide, shallow, gravelly beds, which, becoming dry, are exposed a great part of the year, and having on many places perpendicular rocky banks. Along the fertile margins of the larger streams the usual forest trees of the Southern States are found, not unfrequently also with the cypress (*Taxodium distichum*), and on the slopes, fine cedar woods (*Juniperus Virginianus*) frequently close the view; other pine trees are unknown in this district. On the thin soil of some parts of the country, scattering post-oak woods occur, but on the whole larger timber is scarce.

The climate is mild, not too warm in summer, — in fact, it is said to be not as warm as that of the central portion of the Mississippi valley is from June to August; in winter occasionally ice is seen, but quickly disappears. Farther to the northwest the extremes are greater, and in the southern part of this region frosts are unknown. Spring opens with February, rains occur at that time and often as late as May and June; a season of general drought follows until the September rains again revive the vegetation. It is then that early flowering shrubs often once more begin to blossom, and many annuals again sprout up and bear flowers for the second time, assuming an almost ligneous stem and apparently perennial root, so that it sometimes becomes difficult to decide whether they really are annuals. Some plants, the representatives of which farther north blossom in spring, [225] put forth their flowers only in September or October; as *Oxalis vespertilionis*, the near relative of the common *O. violacea;* and *Ulmus crassifolia*, closely allied to *U. alata.*

As we may expect, the Flora of Southwestern Texas partakes to some extent of the character of the vegetation of the adjoining districts. We find there the *Œnotheræ* and *Gauræ*, the Buffalo-grass, and many other plants from the northern plains. The now well-known Compass Plant of the prairies (*Silphium laciniatum*) is also found there.[1] The western mountain region sends down to the calcareous plateaus a number of grasses, *Yucca angustifolia*, some *Portulacaceæ*, *Nyctagineæ*, and many others.

From the table-lands of Mexico, and particularly its northern slopes, we find in the region we have now in view the *Bolivariæ*, some *Malpighiaceæ*, some *Zygophyllaceæ*, besides the *Mimoseæ* and *Cactaceæ*, to be mentioned more fully hereafter; mostly genera or families not found farther north or east, but species not occurring farther south.

Many herbaceous plants of different families are quite peculiar to that country. Of these I will mention only *Rutosma Texanum*, which with *Peganum Mexicanum*, A. Gray, mss., found south of the Rio Grande is, in America, the only representative of the Rue family. So are the congeners of the remarkable *Hermannia Texana*, common only in South Africa.

But the striking character of the vegetation of that region consists in the diminution of trees into shrubs; they do not disappear entirely as in the western plains and deserts, which extend into northwestern Texas; nor are they generally the same species which elsewhere grow up to be large

[1] It is perhaps not without interest to learn that Mr. Lindheimer has, with the compass, verified the so-called polarity of the radial leaves of this plant. I have no doubt but that sunlight is the determining cause of this peculiarity, as my friend Mr. I. A. Lapham of Milwaukee has suggested. But whether it is the desire, if I may so express myself, of obtaining as much light as possible on both surfaces of the leaf, or perhaps rather a tendency to avoid the burning rays of the noonday sun by presenting to it the edge of the leaf, or both causes together, I leave undetermined. We, at all events, owe our thanks to Major Alvord for having, with a pertinacity which only a thorough conviction of the truth of the fact could have given him, forced the knowledge of a circumstance so interesting to physiological botany on the unwilling mind of naturalists.

trees, reduced in size; but shrubby species, peculiar to that region, represent the larger trees of the same or analogous genera of the more northern parts of the country.

The stately walnut trees of your forests are there reduced to the low *Juglans nana*, a [226] shrub that bears nuts of the size of a musket-ball. In place of the mulberry of your river bottoms, we find there the small *Morus parvifolia*, with leaves of one-fourth the size. The fine hackberry (*Celtis occidentalis*), one of the largest trees on the fertile lands of our western woods, is there represented by a spring shrub of a nearly allied genus, which, not being able to find described in any work within my reach, I have assumed to name *Acanthoceltis*.

In place of the buckeye, from which the citizens of your State sometimes receive a cognomen, we find there the pretty dwarfish *Æsculus discolor*, which, however, also occurs in many Southern States, and the nearly allied *Ungnadia*, peculiar to those regions and remarkable for its small, sweet, but intoxicating and emetic nuts.

The plum trees, not large in the north, become considerably smaller here; so *Prunus rivularis* and especially the very curious *Prunus minutiflora*, the leaves and flowers of which are hardly larger than cranberry leaves. Even the small red-bud tree is there represented by a low shrub, the *Cercis occidentalis*.

All the shrubs just mentioned are representatives of northern trees; but one at least, the *Guajacum angustifolium*, holds the place of a tree, the well-known lignum vitæ.

A few ligneous plants, arborescent along the coast, become shrubby in the region of the calcareous plateaus. So the majestic live-oak, the elegant evergreen *Sophora speciosa*, the valuable *Condalia obovata*, which the settlers use for dyeing blue.

Again other plants, the relatives of which in the north are herbaceous, become there shrubby. Among these I will only mention several *Euphorbiaceæ*, and principally *Crotoneæ*, some *Leguminosæ*, and more than all the *Mimoseæ*. This elegant tribe of plants, considered by some to be the highest type of vegetable development, has towards the north, hardly higher up than the latitude of the Missouri River, only a few struggling low herbaceous representatives; farther south the species become more numerous, but all are herbaceous until coming on the Gulf shore to the *Vachella*, and westward on the Canadian River to the shrubby *Algarobia glandulosa* and *Mimosa borealis*. Only after having crossed the Brazos, and still more the Colorado Rivers, we meet with numerous shrubby *Mimoseæ*, some of them very elegant or very fragrant, and one, the well-known Mezquite (commonly called Muskit) of Southern Texas and Northern Mexico, the same *Algarobia* which has just been mentioned, becomes a large tree, reversing therein the general character of the ligneous plants of that region, important because in some parts of the country it becomes the only firewood.

A large number of these shrubs have long-pointed or shorter-hooked spines; so the [227] *Acanthoceltis*, almost all the *Mimoseæ*, and the *Condalia*, already mentioned; and with them a large number of *Rhamaceæ*, some *Rosaceæ*, *Xanthoxylon*, *Castela*. The pretty *Berberis trifoliolata* has spiny evergreen leaves. Numerous *Yuccas* with acutely pointed leaves (called "Spanish Bayonet"), and the bromeliaceous *Dasylirions*, with sharply serrated leaves, together with the divers representatives of the *Cactus* tribe, complete this peculiar offensive, or rather defensive, character of that vegetation which I am inclined to call the "*Chapparal-flora*," from the Mexican name, indicating dense shrubbery, — a name which has become familiar to us since the war.

The *Cactaceæ* have been alluded to above. They deserve some further notice, as characteristic of that region. A few straggling representatives of this family are found farther north and east. The well-known "Prickly Pear" (*Opuntia vulgaris*) is the only species discovered in the old States; one or two other species of the same genus are found west of the Mississippi, and on the upper waters of the Missouri; and there, also, a few *Mamillariæ* make their appearance. But only after crossing the Brazos River, and entering what I have called Southwestern Texas, you get into the proper region of the *Cactaceæ*, which from there extends southwardly almost through the

whole continent. The northern forms that inhabit the Rio Grande country (and also those of New Mexico) show some peculiarities which distinguish them in some measure from those farther south.

Several species of *Opuntia*, a genus which is more widely distributed over the continent than any other of the family, are found there; most of them of the usual well-known form, with flat joints; some prostrate on the ground; others erect, and often forming stems of six inches' diameter (*Opuntia Lindheimeri*). Another singular tribe of *Opuntiæ*, with cylindrical joints, is there represented by a single slender shrubby species (*Opuntia frutescens*), while to the west and south the splendid tree-like *Opuntia arborescens* borders along the confines of this region. Procumbent *Opuntiæ*, with short club-shaped joints, occurring with the last-named species, can hardly be said to belong to our district.

A number of *Mamillariæ*, several of them with large and beautiful flowers, are frequent there. A large cake-shaped *Echinocactus* (*E. Texensis*) is common all over that region, and a peculiar tribe of that genus, the most common of which is *E. setispinus*, characterized by fleshy berries [228] (the fruits of the *Echinocactus* are generally dry), covered with very thin membranaceous scales, appear to be characteristic of the Flora of the Rio Grande valley. But the most beautiful *Cactaceæ* of that country are the low, as it were stunted, almost globose species of *Cereus* (comprised under the subgenus *Echinocereus*), with delicate flowers, often larger than the plant itself. These forms extend into New Mexico, and into the northern provinces of Mexico, but appear to be unknown farther south, where the species of this family are most fully and most numerously developed. No other genera of this peculiarly American family have been discovered in Texas.

The southwestern part of Texas will soon become better known to us, through the continued exertions of Mr. Lindheimer, and through the praiseworthy exertions of Mr. Chas. Wright, who is now for the second time on his way from San Antonio to El Paso, and of Dr. Bigelow, of your State, attached to the Boundary Survey, who has excellent facilities for exploring the region along the Rio Grande River.

II. GEOGRAPHICAL DISTRIBUTION OF THE NORTH AMERICAN FLORA.*

From the Transactions of the Academy of Science of St. Louis, Vol. III. 1877.

It is well known that the broad belt of timberless land which stretches from the Hud- [cclxx] son Bay regions across the valleys of the Upper Mississippi, Missouri, and the western confluents of these rivers through Texas and into Mexico, separates the floras of the *eastern wooded*, from those of the *western mountainous*, regions of North America. This belt has a flora of its own, which, singularly enough, is little influenced by latitude, at least in its prevailing features, many of the characteristic plants stretching from Manitoba down to the Rio Grande.

The Atlantic and Pacific floras are so completely separated by this belt that scarcely any species of tree of one side is found on the other. Our Red Cedar constitutes one of the very few exceptions.

The Eastern Flora is generally divided into the strictly Atlantic Flora and that of the Mississippi valley. The former includes that of the Alleghany Mountains down to their western declivities, and to the headwaters and upper valleys of the western streams.[1] What we may call

* See also brief remarks on the range and migration of plants and animals in the same number of the Transactions, Journal of Proceedings, pp. ccxxvii and ccxxxi–ccxxxii. — Eds.

[1] Among the interesting facts connected with this floral limit is that the true *Quercus Prinus* is not found west of this line of demarcation, while westward it is represented by *Q. Muhlenbergii*, which, however, also extends eastward, though in a limited degree. The same may be said of *Vitis Labrusca*, which is properly eastern, but is found also on the headwaters of streams flowing westward; farther west it is represented by *V. æstivalis*, common to both floras, some western forms of which have often been mistaken for *Labrusca*.

the Flora of the Mississippi Valley extends westward as far as our common timber trees do, [cclxxi] and down into Texas.

In this connection Dr. Engelmann spoke of the change of the character of the original floras through the agency of man. On the Atlantic coast and in the adjacent country the English settlers evidently introduced many of their weeds, nearly 300 European species being now more or less naturalized, more or less widely spread there. Not half of them have thus far made their way to the Mississippi, but every year some new immigrants arrive and make themselves at home here. Spaniards and Frenchmen brought with them to the Gulf coasts a few other intruders, and Spaniards again brought others into California, some of which, e. g. the wild oats (*Avena fatua*) and the little crane's bill (*Erodium cicutarium*) have completely overrun the country, so that for a long time they were considered indigenous.

In the great seaports another mode of introduction of foreign plants has lately attracted a good deal of attention; I mean that by means of the ballast of ships coming from distant countries, or wool, hides, hay, and other products brought by them. Very few of such plants, however, have become naturalized or have spread; they remain only as temporary or adventitious members of our flora.

A recent means of extending the area of plants is through cattle-droves from the southwest, and especially through the extension of railroads. In this way a good many southwestern and western plants have found their way into Missouri. Such foreign plants often take hold of extensive grounds as "the fittest to survive," to the detriment of the native flora.

It is, therefore, important to observe and note the original flora of a new region at the time of its first settlement, and then watch the progress of the gradual change which pasturing and cultivation of the soil and the various pursuits of man produce. I have to some extent done this in this neighborhood, and can say that I have seen great changes in the local flora during the 45 years in which I have been acquainted with it. Some plants have disappeared, others have come in, and weeds of all sorts have vastly increased: a fit subject for a future paper. — *Journal of Proceedings*, Nov. 19, 1877.

III. THE COMPASS PLANT.*

FROM THE GARDENERS' CHRONICLE, FEB. 26, 1881, N. S. VOL. XV.

IN the paper of January 15, received lately, I notice an account of the Compass Plant (p. 74). When [276] common here, years ago (it is now driven out by cultivation in this neighborhood), I have often examined it with compass in hand. The leaves at their base are arranged, as may be expected, in the ordinary spiral position, but during their development the petiole is twisted so that the blade faces east and west, and its edges point north and south. The stem-leaves being sessile show at their base their original position, but their midrib is turned about the middle, or in the small upper leaves, towards the tip, so that the upper part of the leaf assumes the meridional direction, while the lower part remains fixed in its original position. The large flower-heads, on short and very thick peduncles, are almost invariably turned eastward. Sir Joseph Hooker's remark about the appearance of a plain covered with this *Silphium* [*S. laciniatum*] from a railroad train is quite correct, and any change in the direction of the road becomes visible at once through the altered appearance of the leaves of the Compass Plant. The equal distribution of the stomata on both faces of the leaf is a matter long known to me, and this species of *Silphium* may be readily distinguished from all the others by this character. Only *S. compositum* comes near to it; all the others have a vastly greater number of stomata on the under than on the upper side. But why is that so? In connection with this it is interesting to notice that other *Compositæ* with vertical leaf-blades have a similar anatomical structure. This is especially the case with *Lactuca Scariola*, a plant unknown here before, but extremely abundant now of late years in waste places. Its leaves not only assume a vertical position, but also a meridional one, similar to those of the *Silphium*, though perhaps less pronounced.

* See also a note on the Compass Plant by Engelmann in Bot. Upper Missouri, Hayden (Tr. Am. Phil. Soc. 1861, xii. 196). — EDS.

ADDENDA.

OPUNTIA SUBULATA, *Engelm.* In the grounds of Mr. Thomas Hanbury at Mortola, near Mentone, the interesting Cactus which is well known in cultivation as *Peirescia subulata*, Muhlenpfordt, has bloomed this spring (February), and is now maturing its fruit, and through Mr. Hanbury's kindness I have been enabled to examine fresh specimens; these have fully convinced me of the necessity, long suspected, of removing the species from *Peirescia* to *Opuntia*. My attention was first drawn to this by the observation that the spines of this plant have, at least when first developed, barbs toward their points, and barbed spines (and bristles) are a singular peculiarity of all the members of the genus *Opuntia*, and are not found in any other cactus. This is a curious instance where a vegetative character of apparently minor importance becomes so constant and so exclusive as to at once readily distinguish all the members of this large genus from any other cactus. The barbs in this species are, however, slight, and are apt to disappear in older spines, and the smaller bristly spines generally so abundant (and annoying) in most *Opuntiæ* are almost entirely absent in this species. Another, and the most essential character of the genus *Opuntia*, is found in the expansion of the funiculus, which envelops the ovulum, and finally forms the whitish bony covering of the seed, which, if it was softer, we should call an arillus. This I first discovered in our plant several years ago in an otherwise incomplete specimen, kindly sent by Professor Todaro, of Palermo, and I find it so again in the flower now under inspection. This character is peculiar to all *Opuntias*, and is not seen in any other cactus. *Peirescia*, on the other hand, has the smooth spines and the dark-colored, mostly black, crustaceous seeds (destitute of a bony arillus) of all other *Cactaceæ*. The leaves, being somewhat persistent in *O. subulata*, have probably been the cause of the plant having been referred to *Peirescia* before flower or fruit were known, but more or less persistent leaves are of not rare occurrence in allied *Opuntiæ*, which on this ground have sometimes been referred to *Peirescia;* subulate leaves have thus far not been found in any true *Peirescia*. In this species they are the largest of any *Opuntia* known, 3 to 5 inches in length.

The narrowly pyriform ovary of *O. subulata* is about 3 inches long, and is covered with something like twenty obcordate or rhombo-obcordate depressed tubercles, which bear in the notch a grayish woolly areola, rarely with a few bristles, and under it the thick, subulate, suberect, at last deciduous leaves (outer sepals) $1\frac{1}{2}$ to 2 inches long. About eight small dirty purplish petals, obovate to orbicular, very obtuse, form the corolla; and a few similar but acute sepals make the transition to the calyx. The slender style has about five branches. The only fruit seen was pear-shaped, 4 inches long and $2\frac{1}{4}$ inches thick; the obcordate tubercles still showed their contour quite distinctly in $\frac{3}{13}$ order, but were entirely flat; a few of the upper short sepals were still attached; umbilicus narrow and very deep; eighteen very large seeds were found densely packed in the centre. The seeds were altogether the largest *Opuntia* seeds and probably the largest cactus seeds, seen by me, 5 to 6 lines in the longest diameter, and 3 to 4 or even 5 lines thick, of irregularly angled shape and not flat as *Opuntia* seeds commonly are. A very narrow commissure, the external

part of the funiculus, runs around the seed; the bony coating very thick, albumen very scant, cotyledons contrary to the side of the embryo (as normally in most *Opuntiæ*). Our plant is closely allied to *O. cylindrica*, which, like it, comes also from the west coast of South America.

The *Cylindropuntiæ* differ very materially from the common flat-jointed *Platopuntiæ*, not only by their external form but also by the character of their seed, which is destitute of the broad rim or commissure of the *Platopuntia* seed. They form three natural sections.

1. *Tunicatæ.* — Spines mostly numerous and very irritating, the larger ones covered with a loose sheath; seeds with a comparatively large albumen. Plants usually erect, often tall, wood reticulated, forming a very hard skeleton. Peculiar to Mexico, and especially to the southwestern parts of the United States.

2. *Clavatæ.* — Spines without sheaths, generally annulated, and the larger ones compressed; seed as in the last. Growths low, cæspitose, without a solid skeleton. In the same regions as the last, perhaps also in South America.

3. *Pachyspermæ.* — Spines without sheaths, terete; leaves often somewhat persistent; seeds thick in proportion, albumen often very scanty, or scarcely any; wood unknown; growth tall or low. South America. Of this section I could only study *O. subulata, cylindrica*, and *vestita*, of the West Coast, and with red flowers. Perhaps the yellow-flowering *O. Salmiana* of Brazil also belongs here, and also the different South American *Opuntiæ* classed as *Ovatæ*; the *Platacanthæ*, with flat, flexible spines, I do not know at all; they may form a fourth section.* — *Gardeners' Chronicle*, May 19, 1883, p. 627.

* Directions for collecting Cacti, based on the manuscript of Dr. Engelmann, are published in the Botanical Gazette for June, 1886, vol. xi. pp. 135–136. *Cereus* (*Lepidocereus*) *pecten-aboriginum*, Engelm. in herb., is described by Watson in Proc. Amer. Acad. of Arts and Sciences, n. s., vol. xiii. 1886, pp. 429–430.

It should have been stated at the end of part 2, that a German translation of Dr. Wislizenus's report, by G. M. von Ross, entitled "Denkschrift über eine Reise nach Nord-Mexico," etc., was published in Brunswick in 1850. Dr. Engelmann's paper on the botany of the expedition occupies pp. 140–177. — Eds.

In addition to those enumerated in the preceding pages, and included in the general index, the following names of species or varieties are to be noted: —

Amorpha canescens, var. leptostachya, Engelm. Gray, Plantæ Fendlerianæ, 31.
Apium Butleri, Engelm. Watson, Proc. Amer. Acad. xxi. 453.
Aristida ramosissima Engelm. Gray, Manual, 5 ed. 618.
Boltonia asteroides, var. decurrens, Engelm. Gray, Syn. Fl. i. pt. 2, 166.
Cercis reniformis, Engelm. Scheele, Roem. Texas, 428.
Cyperus erythrorhizos, var. pumilus, Engelm. Britton, Bull. Torrey Bot. Cl. xi. 85.
—— refractus, Engelm. Steud. Cyp. 47 (as *C. retrofractus*); Boeckeler, Linnæa, xxxvi. 369.
Desmanthus brachylobus, var. glandulosus, Engelm. & Gr. Plant. Lindheimer. i. 35.
Dianthera humilis, Engelm. & Gr. Plant. Lindheimer. i. 22.
Erythræa nudicaulis, Engelm. Gray, Proc. Amer. Acad. xvii. 222 (with description of this species and of *Gentiana microcalyx*, Lemmon).
Eupatorium perfoliatum, var. cuneatum, Engelm. Gray, Syn. Fl. i. pt. 2, 100. *E. cuneatum*, Engelm. Torr. & Gr. Fl. ii. 88.
Euphorbia Blodgettii, Engelm. Patterson, Check List, 114 (name only).
—— cuspidata, Engelm. Patterson, Check List, 114 (name only).
—— Garberi, Engelm. Chapman, Flora S. States, Suppl. 646.
—— hirtula, Engelm. Watson, Bot. Calif. ii. 75.
—— mollis, Engelm. Patterson, Check List, 114 (name only).
—— Palmeri, Engelm. Watson, Bot. Calif. ii. 75.
—— peplofolia, Engelm. Patterson, Check List, 114 (name only).
—— platysperma, Engelm. Bot. Calif. ii. 482 (with description).
—— polyphylla, Engelm. Patterson, Check List, 115 (name only).
Euphorbia Pringlei, Engelm. Patterson, Check List, 115 (name only).
—— subpubens, Engelm. Watson, Bot. Calif. ii. 76.
Gentiana Oregana, Engelm. Gray, Syn. Fl. ii. pt. 1, 122.
Gonolobus pubiflorus, Engelm. Plant. Lindheimer. i. 44.
Juglans rupestris, Engelm. Torr. in Sitgreaves's Rep. v. 171, pl. 15.
Lewisia brachycalyx, Engelm. Gray, Proc. Amer. Acad. vii. 400 (with description).
Mamillaria deserti, Engelm. Watson, Bot. Calif. ii. 449.
Marsilia tenuifolia, Engelm. Amer. Journ. Sci. 2 ser. vi. 89.
Menodora scoparia, Engelm. Gray, Bot. Calif. i. 471.
Mentzelia chrysantha, Engelm. Brandegee, Fl. S. W. Col. 237.
Opuntia Bernardina, Patterson, Check List, 48 (name only).
—— versicolor, Patterson, Check List, 49 (name only).
Panicum capillare, var. minimum, Engelm. Vasey, Cat. Grasses, 9.
Paspalum Floridanum, var. glabratum, Engelm. Vasey, l. c. 6.
Petalostemon phleoides, var. microphyllus, Engelm. & Gr. Pl. Lindheimer. i. 7.
Potentilla depauperata, Engelm. Gray, Proc. Amer. Acad. vii. 399. (Ivesia depauperata, Gray.)
Pyrus rivularis var. lævigata, Patterson, Check List, 38 (name).
Quercus Breweri, Engelm. Watson, Bot. Calif. ii. 96.
Sagittaria cristata, Engelm. Arthur, Contrib. Iowa Flora, v. 3.
—— recurva, Engelm. Patterson, Check List, 130 (name only).
Saxifraga debilis, Engelm. Gray, Proc. Phila. Acad. 1863, 62.
Stillingia angustifolia, Engelm. Watson, Proc. Amer. Acad. xviii. 154.
Styrax platanifolia, Engelm. Smithsonian Contrib. vi. 4.

— Eds.

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